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DISK-LIKE ATELECTASES

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I

IN various abdominal diseases one may find peculiar linear shadows in the lower parts of one or both lungs (5, 7, 9). Crossing the bases more or less horizontally, these shadows extend from the cardiac border into marginal areas, commonly at the level of the dome of the diaphragm or a little higher. They are usually almost linear, clearly defined, and

straight, but may also form a triangular ill-defined haziness diverging from the lateral portion of the linear shadow toward the wall of the chest. But for their localization, the formations resemble the shadows produced by thickened interlobar septa. They may be single or multiple, either bilaterally or at one base. In most instances, the corresponding hemidiaphragm is elevated; its respiratory excursions are diminished, absent, or paradoxical, according to the degree of paresis. A small pleural effusion may co-exist.



Fig. 1. Pleural adhesions (autoptic verification). See text.

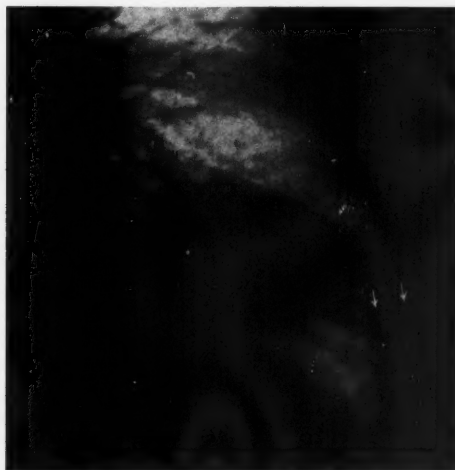


Fig. 2. Disk-like atelectasis in left base (arrows). Bronchitis.

These changes may persist for indefinite periods, or they may subside when the clinical condition improves. It was originally held that this roentgenologic syndrome, pointing to the abdominal cavity as the seat of a disease, should direct the attention to an abdominal lesion in cases which are clinically obscure (2, 9). On the other hand, the finding is not pathognomonic of any particular morbid condition, for it is known to occur in both inflammations and tumors of almost any part of the abdomen, including such different lesions as, *e.g.*, acute pancreatitis, carcinoma of the ovary, perforated duodenal ulcer, splenic enlargement in leukemia, liver abscess, etc. (3, 10).

In the absence of conclusive autoptic findings it was assumed that these shadow lines correspond to circumscribed pleural thickening due to invasion of the pleural cavity by the underlying disease. This explanation has never been quite satisfactory. Pleuritic bands are usually more numerous, less regular in distribution, and associated with tent-like formations of the diaphragm when localized at the bases

(Fig. 1). In two cases in which I had observed the linear shadows in question, autopsy failed to reveal any morbid changes of the pleura. Klima and Pape (8) believed that atelectasis underlies the roentgen findings, but did not obtain autoptic confirmation.

Very recently Fleischner, of Vienna, showed that the linear shadows in the bases correspond, in fact, to a hitherto unknown type of atelectasis which he calls "*plattenförmig*" (*i.e.*, plate-shaped, or disk-like). Whenever respiration becomes shallow, a small bronchus may become obstructed by mucus or muco-pus, especially in the presence of increased bronchial secretion. This obviously leads to atelectatic collapse of the corresponding part of the lung; the collapsed portion retracts; the negative pressure in the pleural cavity and the comparative rigidity of the thoracic walls counteract or resist retraction, but the surrounding normal pulmonary tissue, being very elastic, yields by allowing the alveoli to dilate: consequently, the collapsed portion retracts by stretching the normal lung above and be-

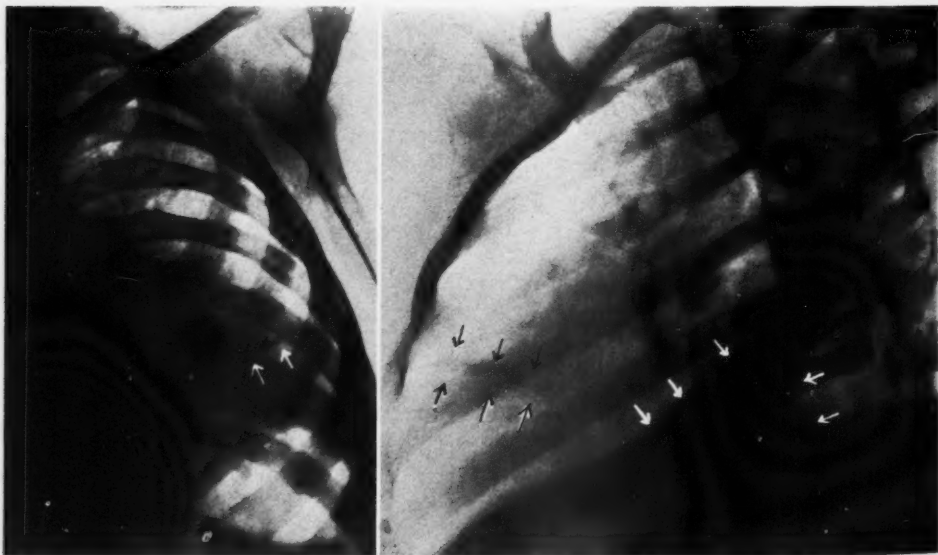


Fig. 3. Anteroposterior and left oblique view. In the anteroposterior view, a linear shadow (arrows) is superimposed to an ill-defined hazy area; in the oblique view, the latter corresponds to a triangular atelectasis (white arrows), while the disk-like atelectasis is seen in front of it (black arrows). Esophagus filled with barium.

low it, but it itself remains stretched between the obstructed bronchus and the pleural surface of the lung. Hence the almost linear appearance and the more or less horizontal position of the shadow that corresponds to the atelectatic region. Fleischner describes this pathogenetic mechanism as "*gerichteter Kollaps*" (2, 3); the term indicates that in these cases collapse is oriented, or directed, by the concurrent forces of retraction, elasticity, and resistance. It is evident that this type of collapse occurs only when the atelectatic area is small and the surrounding lung tissue elastic; otherwise, the more common form of atelectasis develops, for example, as a triangular shadow radiating from the hilus downward. In accordance with well-known work of American authors (1, 6), Fleischner ascribes the production of this condition to shallow breathing as induced by pain, by inflammation in the neighborhood of the diaphragm, by exhaus-

tion causing weakness of respiratory movements, and the like.

In the majority of cases, disk-like atelectasis is transient, for it either resolves or is followed by pneumonic infiltration (drowned lung), especially *sub finem*. Hence, it is quite difficult to obtain autptic verification. After many failures, Fleischner finally succeeded in substantiating his views by the results of two necropsies. We are able to add a third autptic confirmation from our own experience, to be reported hereafter.

II

Statistical data concerning the incidence of disk-like atelectases are not yet available. In reviewing 1,000 examinations made in 1936, I found six cases. Among 482 examinations made more recently there were 11 cases. The discrepancy obviously is due to the fact that of late we have

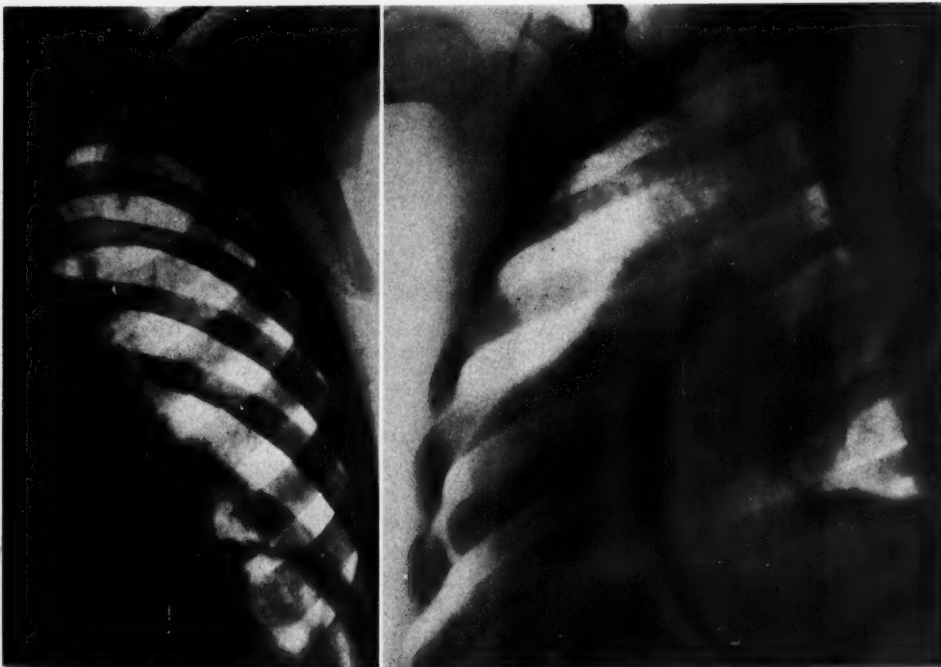


Fig. 4. Same case as Figure 3; roentgenographs taken 32 hours later (see text). Lung-fields now perfectly clear. Diaphragm lower than before.

paid more attention to this condition, and that we have examined a larger number of patients in whom we expected to find it. Precise figures are difficult to obtain anyway; for, as mentioned above, in its

leukocytosis, and no other sign of inflammation or infection. The child was unable to cough. Feeding had become difficult. Roentgen examination showed in the left lower lobe a horizontal linear, and

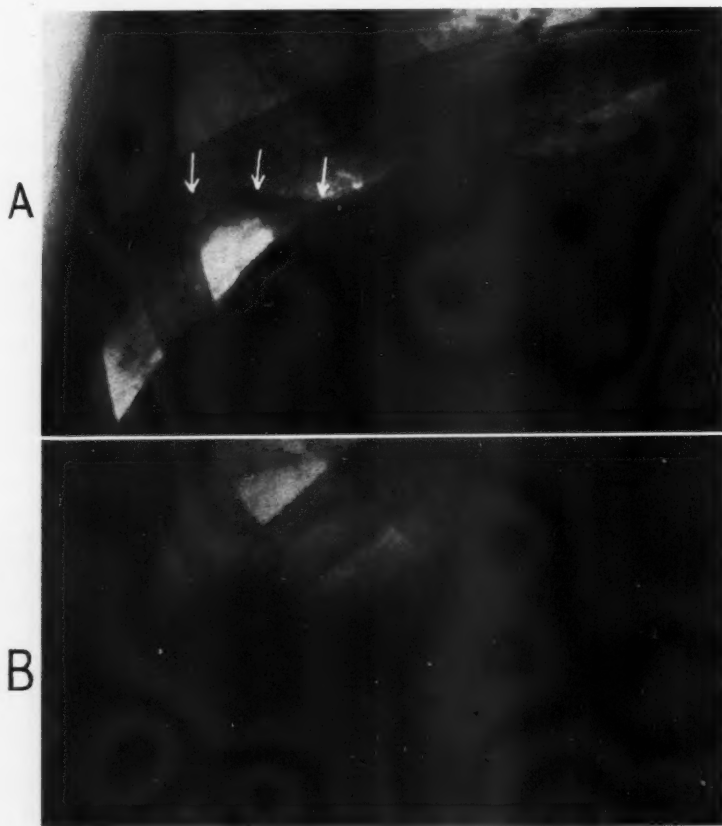


Fig. 5. Fifteen minutes after a fall, a disk-like atelectasis is seen in the right lower lobe (arrows); the fractured rib is not included in the roentgenograph (A). The right base shows pneumonic infiltration 20 hours later (B). See text.

unaltered form, disk-like atelectasis usually is transient: as soon as bronchial obstruction ceases, the lungs regain normal radiolucence. For example, in a girl two years of age, the linear shadow was found to have disappeared a couple of hours after normal respiration had become possible (Fig. 4). There had been difficulty in breathing off and on for a few weeks previous; tubular breathing was found in a small area of the left lower lobe; there was no fever, no

a triangular homogeneous shadow. The lumen of the corresponding bronchus, visible by its air filling, seemed irregularly narrowed (Fig. 3). X-ray diagnosis: two areas of atelectasis due to bronchial obstruction, probably by mucus. Suddenly, respiration became normal, the child asked for food, and, a few hours later, roentgenographs showed that both the linear and the triangular shadow had entirely disappeared (Fig. 4).

On the other hand, atelectasis of this type is often rapidly complicated by inflow of exudate into the alveoli ("*atelektatische Anschoppung*"), as illustrated by the following example: a man 63 years of age fell on the street in front of our hospital. Within 15 minutes after the fall, roentgenographs of the lungs were taken. The right ninth rib was found fractured at its junction with the calcified cartilaginous portion. A linear horizontal shadow was seen crossing the right base (Fig. 5-A). Owing to inhibition of all respiratory movements because of pain in the injured side of the chest, the right intercostal spaces were greatly narrowed, while the right hemidiaphragm was elevated, and there was scoliotic position of the dorsal spine with the concavity to the left side. There was a well-marked prominence of bronchial markings in both bases. X-ray diagnosis: fracture of right ninth rib, chronic bronchitis, disk-like atelectasis in right lower lobe. Twenty hours later, the patient's condition became worse, and roentgenographs showed pneumonic infiltration in the region previously occupied by the linear shadow (Fig. 5-B).

In some instances, however, the atelectatic part may remain disk-shaped for long periods, as shown by the following observation. In a man 54 years of age a small carcinoma of the pyloric region had produced very large metastases in the liver. The right diaphragm was elevated and immovable. There were linear shadows in both bases (Fig. 6). Five weeks after this examination, the patient died. Autopsy was made by Dr. Ph. F. Sahyoun, and I am indebted to him and to Dr. E. Mayer for permission to publish the results of the examinations. In the left lung, about 1 cm. above the diaphragm, there is an atelectatic area 2 cm. long, extending from the anterior margin into the pulmonary tissue. The right base shows atelectasis and hypostatic pneumonia. Pleura smooth and shiny, no adhesions, no thickening, no effusion. Microscopically, the left atelectasis shows theselastic fibers crowded together; some small

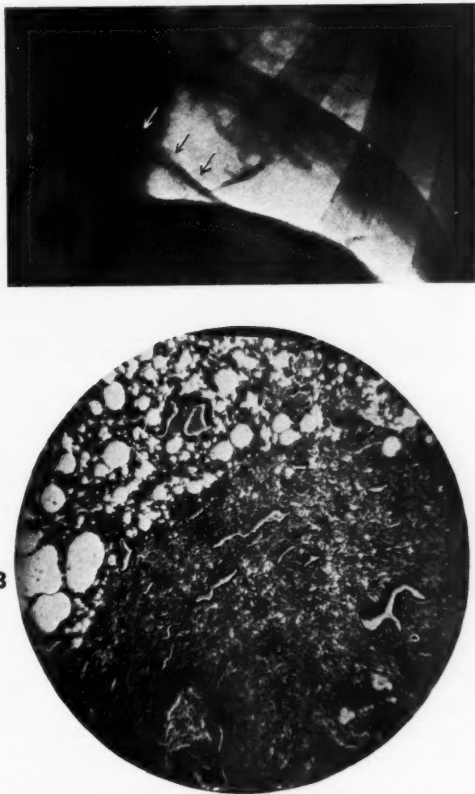


Fig. 6. Roentgenograph (6-A) and photomicrograph (6-B) of disk-like atelectasis in left base. Verhoeff elastica stain, low power magnification. The left upper part shows normal, the right lower part atelectatic lung tissue. See text.



Fig. 7. Deviation of interlobar septum (white arrows), with a sharp angle (x) due to traction by a disk-like atelectasis (black arrows). Retouched.

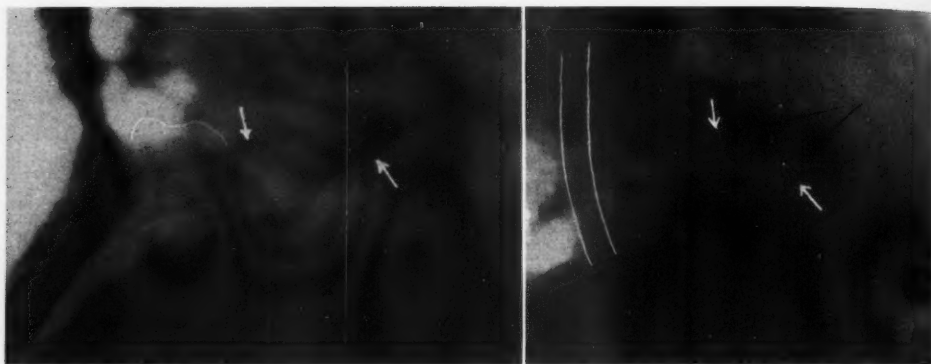


Fig. 8. Deviation of esophagus during forced inspiration (*left*). No deviation during expiration (*right*; retouched). A disk-like atelectasis (arrows). See text.

bronchi contain mucus, others epithelium (post-mortal). The alveoli in the normal adjacent parts are rounded. There are a few thrombosed capillaries in the neighborhood of the atelectatic area. In size, shape, and localization, this atelectatic area corresponded to the linear shadow seen roentgenologically; and it is noteworthy that the pleura was found normal. The atelectasis in the right base obviously was complicated by pneumonic infiltration during the interval between roentgenologic and autoptic examination. Unlike Fleisch-

ner, we did not find in our case the elastic fibers in the atelectatic area arranged horizontally, nor the alveoli in the surrounding tissues elongated. Nevertheless, the findings confirm Fleischner's observations and prove that the linear shadows in question actually correspond to atelectases of a peculiar type, but are not due to pleural thickening.

The cases above described are merely illustrations to show the various factors involved in the production of disk-like atelectases. Shallow breathing is obviously an essential cause, irrespective of the condition underlying it. Besides the above instances, disk-like atelectases were found by us in one patient with acute cholecystitis; in two elderly people with bronchitis; in the presence of a small foreign body in the lower bronchus; in two cases of resolving pneumonia; in one patient with obscure bronchial stenosis; and in several instances in which complete clinical data are not available. The youngest of our patients was 2 years old, the eldest 76; nine were males, seven females. The type of chest, flat, short, or broad, does not play any part in this respect.

III

In the differential diagnosis, deviation of neighboring organs toward the atelectatic region is an important finding. Al-

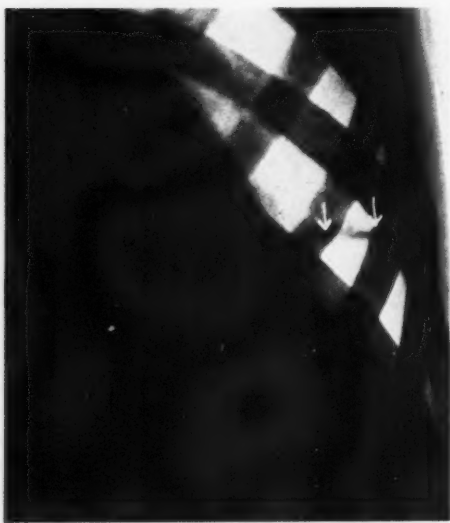


Fig. 9. Disk-like atelectasis in left lower lobe after resolution of lobar pneumonia.

though, of course, not pathognomonic of atelectasis, this deviation of, *e.g.*, the mediastinum, is significant in correlation with other roentgen signs of pulmonary collapse. In a discerning study of these secondary or accompanying changes, Fleischner showed that interlobar septa may become displaced toward the collapsed region at its level (4); he also found in the presence of disk-like atelectasis a normal stomach shifted upward in the supine position when the right diaphragm was relaxed (2). In one case (Fig. 7), deviation of the septum was also found by us; in another, I saw the esophagus shift toward the collapsed area (Fig. 8); the fact that this displacement occurred only during forced inspiration, but was absent during expiration, supports the view that collapse occurs in discoidal form when the power of retraction is outweighed by the resistance of the walls of the chest, wherefore during inspiratory expansion of the chest the collapsed area retracts organs that are movable. Of course, no displacement occurs when the mediastinal organs are bulky, rigid, or fixed by some morbid process, as in cardiac enlargement, pericardial effusion, aortic sclerosis, etc. Generally speaking, and in any type of atelectasis, displacement of the mediastinum is more marked in children than in adults, because obviously the juvenile organs are less strongly fixed by connective tissue, the latter being more elastic in young persons.

Theoretically, one may anticipate that in some cases it will be difficult to differentiate between a disk-like atelectasis and a thickened interlobar septum; but in practice we have not yet met with this question, the localization having been quite different from that of the interlobar fissures, even from those of supernumerary lobes. The complete disappearance of the shadows within a few hours could not possibly be accounted for by any form of

interlobar pleurisy. Besides the latter, there is no other morbid condition we know of that produces similar roentgen findings.

SUMMARY

The roentgenologic appearance of a peculiar type of atelectatic collapse is discussed. Linear shadows in the bases are shown to be due to disk-like atelectases, as already described by Fleischner. Clinical and autoptic findings suggest a correlation with impaired respiration. The collapsed area may re-expand within a few hours, and the shadows disappear; but the collapse may also be complicated by pneumonic infiltration. There is no direct correlation with any type of abdominal disease; indirectly, such a disease may be responsible for atelectasis when it leads to shallow breathing. The shadows in question are not due to pleural thickening, as evinced by the results of autopsy.

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THE ROENTGEN DIAGNOSIS OF INTUSSUSCEPTION

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ROENTGEN examination has been used rather extensively in the diagnosis of intussusception since Ladd (1), in 1913, and Lehmann (2) and Groedel (3), in 1914, first demonstrated its diagnostic value. The purpose of this report is to evaluate the roentgen criteria of intestinal invagination and to present the roentgenographic observations in a series of seven patients.

Intussusception usually occurs in infancy. Although many theories have been postulated (4), the exciting causes (in infants) are not definitely known. In older children and adults, the predisposing conditions include ulceration of the bowel, Meckel's diverticulum, and abnormal growths such as polyps, myomas, lipomas, or cysts (5). Malignant tumors which grow in the direction of the bowel lumen and do not cause fixation of the intestine to surrounding structures may also cause invagination.

The symptoms (6) are periodic attacks of colicky abdominal pain, vomiting, and diarrhea with the passage of blood and mucus per rectum. On physical examination, an abdominal tumor may be palpable. This mass can change in contour and location, and may even disappear. Since the x-ray signs are correlated with the underlying structural changes, a preliminary consideration of the pathology is essential to this discussion.

Most invaginations are of the so-called descending variety. One portion of the bowel wall invaginates into the lumen of an adjacent part of the gut. The intussusception is thus comprised of intussusceptum, consisting of an entering tube and returning layer, and intussusciens, the sheath or receiving tube.

The four common types (7) are:

1. Ileocecal—the most frequent, in which the ileum and ileocecal valve pass into the cecum.
2. Colic—in which the large intestine is prolapsed into itself.
3. Enteric (ileal)—in which the small bowel alone is involved.
4. Ileocolic—in which the ileum prolapses through the ileocecal valve.

The growth of an intussusception occurs exclusively at the neck of the intussusciens. The driving force is supplied entirely by the ensheathing layer. Its circular fibers contract strongly above, driving the intussusception on and forming a fixed point from which the longitudinal fibers can act (8). There may be considerable space between the sheath and the invaginated portion, especially in the ileocolic type, allowing great mobility of the intussusception, and accounting for the spontaneous reduction which frequently occurs (9, 10). The obstruction is produced by the contraction of the sheath, as well as by the intussusceptum (7). An actual block does not exist and the continuity of the intestinal lumen between oral and distal segments remains intact. However, the twisting and compression of the mesentery impairs the blood supply of the invaginated portion. The intussusceptum becomes congested and edematous so that it fills the intussusciens completely. Ulceration, gangrene, and perforation may follow. Adhesions (11), as well as edema, prevent reduction, and usually develop between the two layers of the intussusceptum, due to a local inflammation. The further consequences are stenosis and complete obstruction. The proximal bowel becomes distended, the haustra are stretched, and potential spaces appear between the separated plicæ. The dis-

tinguishing feature in chronic intussusception is incomplete obstruction of the bowel lumen. There is usually little, if any, interference with the blood supply. The intussusceptum is constantly changing, no edematous segment of gut is produced, and occlusion of the bowel is more or less intermittent. In acute invaginations the ensheathing cylinder shows little change, aside from congestion. In the chronic type it may be considerably thickened (7).

The diagnostic value of roentgen examination in intussusception has been questioned by Panter (12), who emphasizes the variability in findings and claims that stenosis is the only possible diagnosis to be derived from this procedure. Porcher (13) likewise believes that there are no pathognomonic findings, and he presents in evidence three cases diagnosed as intussusception by x-ray in which operation disclosed tuberculosis of the bowel, neoplasm with volvulus, and congenital non-rotation of the bowel with stenosis. There have been several reports of negative roentgen examinations in subsequently proved cases of intussusception (14, 15). It is possible that the examination was done at a time when the invagination was spontaneously reduced. Aside from these isolated accounts, the evidence accumulated in numerous case reports (16, 17, 18) indicates that roentgen examination is a helpful diagnostic method in bowel invaginations. While Da Costa (19) urged its use in all suspected cases of intussusception, it is generally agreed that the x-ray is most valuable in the diagnosis of atypical subacute and chronic types of obstruction (20).

The relative merits of the opaque meal and the barium enema have been considered only occasionally. Renander (21) and Edberg (22) favor the oral type of examination. In the case studies of Groedel (3) and Altschul (23), this method gave positive findings, whereas colon fluoroscopy was negative. Castronovo (24) and Panter (12) advocate the use of both procedures. It is possible, according to the latter, to obtain roentgen findings with an opaque meal just as characteristic and

illustrative of all details as with the opaque enema. However, the barium meal has given negative results in cases of intussusception diagnosed by the barium enema (2, 12). The few descriptions of roentgen findings with the opaque meal have emphasized obstruction, filling defect, and alterations in the caliber of the bowel, and in the position of the cecum and ileocecal valve. Other observations include distention of the haustra proximal to the obstruction (21) and delayed emptying time of the ileum (25) due to a relative stenosis produced by the invagination. Ashbury (26) and Weaver (27) have also reported the ileum apparently entering the cecum posteriorly. The significance of this finding is questionable since it has been observed in normal cases (28). The barium meal is of greatest value in the diagnosis of small bowel invaginations. In all other types, colon fluoroscopy is to be preferred. It not only shows the anatomy of the colon to better advantage, but is desirable because it is less likely to interfere with subsequent surgery. The use of post-evacuation films is recommended since they frequently give excellent views of the mucosal pattern. Jacobi and Lust (29) recently have demonstrated the advantages of mucosal relief study of the colon.

As the enema is administered, a hindrance to the flow of barium usually occurs. This obstruction is produced by the apex of the intussusceptum and the contraction of the ensheathing layer. If the invagination is loose, the obstruction will often recede for a varying distance by increasing the pressure of the enema. Under such circumstances there is an irregular filling of the colon proximally (21). Complete reduction may result, allowing the colon to fill out normally. This fact has encouraged the use of the barium enema for therapeutic as well as diagnostic purposes in selected cases (30, 31). This movable type of obstruction has been reported by many authors. It is more likely to occur in chronic recurrent invaginations in which the blood supply of the intussusceptum is not appreciably impaired. In

the one case in which it was not observed, our x-ray diagnosis of intussusception proved erroneous. In another patient, the obstruction was partially movable despite the presence of fibrous adhesions. Movable obstruction is not completely diagnostic of intussusception since pedunculated tumors can give similar findings (21, 32). If barium is able to pass between the sheath and the invaginated portion, a characteristic forking of the contrast substance occurs at the point of obstruction. The barium diverges into two narrow channels enclosing the intussusceptum as a thin cylindric shell within the intussusciens (34, 35, 36). The length of the forking depends on the length of the invagination and on the anatomic space between the cylinders. It is possible, of course, that any rounded mass projecting into the lumen of the bowel, but not completely obstructing it, will present a similar appearance. Baastrup (37), for example, has observed a forked opaque meal shadow due to an enormous coprolith, measuring 8×12 cm. The barium will then enclose a central filling defect, either rounded or cone-shaped, corresponding to the intussusceptum. This defect is not commonly found in other lesions causing obstruction (36). If the intussusception is fixed, the barium enema will be completely obstructed, although this obstruction, in itself, is not characteristic. A cupola effect, or cupping in the column of barium, is produced as the contrast substance meets the intussusceptum (22, 31, 35). The barium then assumes a U-shaped configuration. While this deformity has been frequently described (30, 31) we have noted it in only one case. Kerley and LeWald (18) consider it characteristic of intestinal invagination. The haustra of the bowel about the mass are often distended (21). Barium fills the spaces between the stretched plicae, and a typical appearance, likened by Muff to an accordion, can be visualized. Case 5 demonstrates this feature. A tumor corresponding to the filling defect is often palpable at the site of obstruction (26, 32, 33). Under manipula-

tion this mass is likely to alter in size or shape depending on the degree of reduction of the invagination, in contrast to the usually more fixed nature of a carcinoma of the colon. It should be emphasized, in this connection, that what may appear to be a partial reduction actually can represent complete disinvagination with the persistent filling defect now representing tumor. This occurred in Case 7.

If barium enters the lumen of the intussusceptum, its shadow appears in the center of the defect as a streak parallel to the long axis of the intestine (38). Although Davis and Parker (36) have also made this observation in one of their cases, it is an infrequent finding. The normal mucosal appearance of the large bowel shows a certain symmetry in the pattern of the folds (39). Transverse folds predominate in the cecum, ascending, and transverse colon; longitudinal folds are present in the descending colon and sigmoid. Alterations in the mucosal pattern of the colon occur in intussusception as well as in other conditions. In fact, Sussman (33) reported compression of adjacent mucosal folds in one of his cases; stretched mucosal folds have also been described (40).

The mucosa of the ileum appeared unusually swollen in a case of carcinoma of the cecum with ileocolic invagination (41). This abnormal pattern may represent edema as a result of irritation by the intussusception. A similar appearance has been noted in one of our cases (Case 7), also a carcinoma of the cecum with an ileocolic invagination. Since Templeton has noted this finding in carcinoma without intussusception, it is possible that the localized mucosal swelling chiefly represents tumor infiltration. Indeed, the "relief" picture in malignancy often shows rounded or irregular filling defects with collections of contrast medium in the crater-like depressions on the surface of the tumor (39). Proper evaluation of this mucosal abnormality is not possible at present and must await further studies of the mucosal pattern of the colon in pathologic conditions.

CASE 1

N. B., a three-month-old male infant was brought to the hospital because of regurgitation of his feedings and the passage of a stool containing mucus and blood. On examination, slight tenderness was elicited over the right upper quadrant of the abdomen. The patient was observed to cry out at 15- to 20-minute intervals as if in pain, the abdominal tenderness increased, and rigidity was noted over the ascending colon. Several more bloody stools were passed. The next day, moderate abdominal distention was present and a questionable mass appeared in the right upper quadrant. On rectal examination, no masses were felt but a large amount of mucus and blood-tinged fluid was passed. Intussusception was considered and the patient was referred for roentgen studies. At colon fluoroscopy the barium was seen to hesitate for some time at the splenic flexure, the colon then filling slowly. Under manipulation, the barium passed across to what was thought to be the hepatic flexure (one observer considered it cecum). The remainder of the colon and the small bowel could not be filled. The roentgen impression was intussusception, but surgical interference was deferred. The patient continued to be distended, and a questionable, rounded mass was again felt two inches below the liver. The same evening, however, there was a distinct improvement; the patient expelled flatus, he retained water given by mouth, and his cry became more lusty. Several loose stools were passed containing small amounts of blood and mucus. He was discharged at this time, against advice. Four months later, in response to a follow-up letter, it was learned that the patient had been in excellent health.

Impression.—Probable ileocolic intussusception—spontaneously reduced.

Comment.—The roentgen findings in this case are merely those of a temporary and movable obstruction. Despite the absence of such typical signs as filling defect or U-shaped deformity, in view of the defi-

nite clinical picture intussusception was most likely. It is possible, also, that the enema aided in the spontaneous reduction of the intussusception.

CASE 2

G. B., a four-year-old girl complained of abdominal cramps, nausea, vomiting, and diarrhea for two days. On the day of admission she experienced intermittent cramping pain with watery bowel movements almost every hour. The abdomen was soft. There was an oval tumor palpable just below the umbilicus and extending almost to the symphysis. This mass was rather hard, smooth, and movable, and could be felt on rectal examination. More bloody stools were passed, but on examination several hours later, the mass could not be located. With a barium enema the entire colon filled easily and completely. A mass which was palpable at the beginning of the examination had disappeared at its close. The appendix was seen and the terminal ileum filled. Conservative management was continued and for three days the patient improved. At this time the abdominal mass noted originally was again palpable. The patient also passed a formed stool streaked with blood. A tentative diagnosis of recurrent intussusception was made and the patient was transferred to surgery. At operation a large amount of clear yellow fluid escaped from the peritoneal cavity. An intussusception was found involving 20 cm. of ileum. This portion of the bowel appeared obviously damaged and a small perforation was seen in the intussusception. The entire involved bowel was resected and the ends of the small intestine were brought to the surface as a gun barrel fistula. The patient made a gradual recovery after the two loops of bowel were united. She has had no further difficulty with her gastro-intestinal tract. The surgical specimen consisted of 36 cm. of ileum; the pathologic diagnosis was gangrene of small intestine.

Impression.—Recurrent ileo-ileal in-

tussusception with gangrene of involved small intestine.

Comment.—The disappearance of the palpable abdominal mass at the completion of the x-ray examination indicated

mass lying transversely above the umbilicus was palpable. Intussusception was suspected and the patient was referred for roentgen studies. With a barium enema, difficulty was experienced in filling a re-



Fig. 1.

Fig. 1. Case 3. Colon completely filled to the hepatic flexure where a convex intraluminal obstruction is shown. Barium is present between the intussusceptum and intussusciens.



Fig. 2.

Fig. 2. Case 3. Illustrates partial reduction of the invagination as a result of the enema. The tumor of the ileum projecting into the cecum is well outlined by thin lines of barium.

that the pressure of the enema was sufficient to reduce the intussusception. Many similar cases have been described in the literature. The recurrence, of course, necessitated surgical interference.

CASE 3

W. M., an eight-month-old male infant, for two weeks before admission had experienced abdominal pain, evidenced by a drawing up of his legs and crying. There was occasional vomiting, but the stools were normal. The symptoms then disappeared, except for a mild attack of pain and vomiting one week prior to admission. Two days before entry the vomiting recurred and enemas yielded a small amount of fecal material, not containing blood. On examination the patient was well developed and nourished, crying intermittently as if in pain. A sausage-shaped

dundant descending loop of colon. There appeared to be an obstruction which receded in the face of the advancing barium column, probably invaginated bowel which was being pushed out of the transverse colon. A film taken at this stage showed complete filling of the colon to the junction of the proximal and middle thirds of the transverse colon. The injection of barium was continued, whereupon the patient had an explosive defecation, after which barium passed on farther into the colon. Evidently this was due to a release of the intussusception, allowing gas and other contents of the small bowel to be evacuated. A second film showed a vague mass faintly outlined by barium in the cecum. At fluoroscopy the next day the colon was easily filled to the region of the cecum at which point a large mass, believed to be the intussusception, was visu-

alized. Examination indicated that barium given previously had left the intestinal tract. This time the colon filled promptly and completely, as far as the hepatic flexure, where there was a complete obstruction to the barium. An egg-shaped mass, measuring 40×25 mm., was outlined.

At operation a tumor mass was palpated in the ileocecal region and found to be an ileocolic intussusception. This was partially reduced, further progress being prevented by firm fibrous adhesions. A tense, round mass, measuring 3.5 cm. in diameter, was palpated at the ileocecal junction. It could be pressed forward into the cecum, or backward into the ileum, in which latter case it seemed to produce a complete obstruction. The tumor, 15 cm. of ileum, the cecum, and a portion of the ascending colon were excised, and a lateral anastomosis was made between the proximal ileum and the transverse colon. The patient experienced a rather stormy post-operative course but gradually improved, and was discharged from the hospital the twelfth post-operative day. The pathologic diagnosis was enterocystoma of the ileum with ileocolic intussusception.

One month later the patient re-entered the hospital because of vomiting of two days' duration. He was moderately ill and somewhat dehydrated. The abdominal incision was well-healed. An indefinite mass was felt in the right upper quadrant. Rectal examination was negative. With barium enema, the colon filled up to the point of anastomosis of the colon with the ileum. A diagnosis of recurrent intussusception was made and the patient was again operated upon. An intussusception of the ascending into the transverse colon was found, producing an obstruction between the ileum and the transverse colon. This was reduced and the end of the ascending colon was sutured to the anterior abdominal wall to prevent further recurrence. The subsequent course was uneventful. The stools became normal and the patient was discharged two weeks after admission. He has since been in excellent health.

Impression.—Ileocolic intussusception due to enterocystoma of the ileum with recurrent, post-operative intussusception of the ascending into the transverse colon.

Comment.—This case demonstrates several of the accepted roentgen criteria for the diagnosis of intussusception: (1) Obstruction to the column of barium; (2) A palpable mass at the site of the obstruction; (3) An intraluminal filling defect outlined by thin streams of barium passing between the intussusceptum and the intussusciens. Here, also, the enema effected a partial reduction of the invagination.

It is interesting to note that in spite of the firm, fibrous adhesions found at operation, the obstruction possessed a certain degree of mobility. Enterocystoma of the ileum as a cause of intussusception is infrequent in the literature. An enterocystoma of the ileum without intussusception was discovered in another case not included in this series.

CASE 4

J. R., a 51-year-old male entered the clinic with a history of intermittent, mid-abdominal pain, rumbling, gurgling, vomiting, and constipation, all of one month's duration. There had been a weight loss of from 15 to 20 pounds. Physical examination revealed evidence of a mild secondary anemia. The patient was admitted to the hospital for more complete studies. With oral barium the esophagus, stomach, and duodenal bulb were normal. There was an unexplained broadness of caliber of the terminal ileum. At colon fluoroscopy, the sigmoid and descending colon lay on the right side; the splenic flexure was in its usual position. The cecum lay well up beneath the liver. Films of the completely filled and partially filled colon did not show any organic lesion. Another film, however, after defecation, demonstrated a large globular mass of barium in the right upper quadrant. Below this mass of barium was a faint shadow which had colonic haustra. The

incomplete filling of the ascending colon and cecum was attributed to an intussusception in the region of the hepatic flexure. Several films taken for mucosal study showed barium scattered throughout the



Fig. 3. Case 4. Film of the filled colon demonstrating no lesion.

descending and transverse colon. A polypoid mass in the region of the hepatic flexure was noted. At the second colon fluoroscopy, the colon filled rapidly. A redundant loop of sigmoid and colon lay on the right side. The splenic flexure was in normal position. The enema stopped abruptly in the region of the hepatic flexure. On compression, a faint polypoid mass could be made out through the barium shadow. When the patient was turned, the colon appeared to expand around this mass. Barium could not be forced beyond this point of obstruction. After evacuation of the enema a film again demonstrated the mass, which appeared invaginated into the normal colon. There was an abrupt demarcation between this mass and normal, collapsed colon. The x-ray impression was intussusception sec-

ondary to carcinoma of the hepatic flexure. The intussusception apparently had occurred after the initial examination one week earlier.

At operation no intussusception was discovered. An intraluminal carcinoma of the hepatic flexure, 10 cm. in diameter, was found attached by fibrous adhesions to the gall bladder. There were no gross visceral metastases. The mass was resected and an ileo-transverse colostomy performed. Recovery was uneventful. The patient was seen in the clinic three months later. He had been quite well and had had regular bowel movements. There were no palpable abdominal masses.

Diagnosis.—Carcinoma of hepatic flexure of colon with partial bowel obstruction.

Comment.—This case illustrates that the accepted criteria for the roentgen diagnosis of intussusception do not always hold. In favor of the diagnosis was the presence of an obstruction with an intraluminal filling defect and palpable mass; also the incomplete filling of the ascending colon and cecum. On the film, the mass did appear to be invaginated into the hepatic flexure. Against the diagnosis, possibly, was the fixation of the mass and the abrupt transition from normal to pathologic bowel. It is possible, of course, that an intussusception did exist at the time of fluoroscopy, and had reduced itself. But this would seem unlikely in view of the presence of fibrous adhesions surrounding the mass. The lesion was not shown on a film of the filled colon.

CASE 5

L. C., a boy six years of age, had been well until approximately three months previously. At this time he complained of low abdominal pain of an intermittent, recurrent nature. There were frequent vomiting spells every one to two days. His appetite had failed gradually and he had lost 20 pounds at the time of admission. The stools were hard, but otherwise negative. On examination the patient was

rather emaciated. The heart and lungs were normal. The abdomen was very tense and board-like. Rectal examination was negative. There were palpable lymph nodes in both inguinal regions. Roent-

easily but at about the middle of the transverse colon there seemed to be a complete obstruction caused by a large mass. A film showed an irregular, fine serration of the transverse colon distal



Fig. 4.

Fig. 4. Case 4. Post-evacuation mucosal film. Redundant sigmoid lies on the right side. There is a polypoid mass in the hepatic flexure. Gas and fecal material outline the ascending colon. The mucosal pattern of the transverse, descending, and rectal portions of the colon is well shown.



Fig. 5.

Fig. 5. Case 5. Excellent demonstration of the presence of barium between the stretched bowel plicae giving the so-called "accordion-like" or "concertina-like" appearance. Proximal to this, dilated colon is outlined by gas and shows stretched circular plicae. The serrated appearance of the colon distal to the invagination has been described by Berg as indicative of mucosal edema.

genograms of the chest revealed a widened mediastinal shadow, apparently caused by a soft tissue-mass lying to the right of the aorta—possibly enlarged lymph nodes. Five days after admission, a firm, non-tender, and freely movable lump was felt just below the liver in the midclavicular line. One hour later this mass had moved to a point midway between the right upper and lower quadrants. Intussusception was suspected and roentgen studies were recommended. Abdominal films showed the presence of gas in the stomach and small intestine, on the left side of the abdomen, and in the pelvis. These findings suggested a bowel obstruction and a barium enema was attempted. The colon filled

to a large dilatation. The mid-portion of the transverse colon displayed an abrupt dilatation of bowel resulting in multiple, fine, transverse lines of barium, apparently lodged between the plicae of the distended colon. The roentgen impression was invagination of the cecum and probably terminal ileum into the ascending and proximal transverse colon, and also infiltration of the remainder of the transverse colon, most marked just beyond the end of the intussusception (possibly secondary inflammation or edema).

At operation, the palpable mass was found to consist of huge, retroperitoneal glands lying in the upper portion of the right lower quadrant. Above this lay the

intussusception. It was not hemorrhagic or gangrenous, but all attempts at reduction failed. This mass was ileum which had progressed into the descending colon and was quite hard and nodular, suggesting the presence of a tumor. The entire mass was exteriorized in a first stage Mikulicz operation. Two days later the second stage was completed. The intussuscepted mass was removed with cautery and the ileostomy left open. Post-operative recovery was satisfactory and the patient was discharged in three weeks with a well-functioning ileostomy. The final pathologic diagnosis was round-cell sarcoma of the ileum causing intussusception. One month later the ileostomy was closed. No abdominal masses were found at this time. The patient has received roentgen therapy.

Diagnosis.—Round-cell sarcoma of the ileum with ileocolic intussusception.

Comment.—The film appearance of the colon in this case is interesting. The serrations of the transverse colon apparently were caused by infiltration of the bowel wall with tumor tissue. This type of haustration has been attributed by Berg (42) to diffuse mucosal edema. The "accordion" appearance of the dilatation, originally described by Muff (32), is due to barium caught between stretched plicæ. The roentgen evidence here is quite characteristic for intussusception.

CASE 6

U. M., a boy seven months of age, had passed several bloody stools three weeks previously. He was then apparently well until three days before admission, when the bloody stools reappeared, accompanied by abdominal soreness and vomiting. A barium enema was attempted, and, although the child had difficulty in retaining the enema, it was observed that the rectum, sigmoid, and distal transverse colon filled out normally. The barium was stopped in the transverse colon, forming a bulbous expansion with a cup-like depression in its center. The fluoroscopic evidence suggested intussusception, although from the film appearance of the colon all

that could reasonably be concluded was that the colon was obstructed by an intraluminal mass producing a convexity at the site of the obstruction.

At operation, a large mass was felt under the liver. The operation was then interrupted due to struggling during the change of anesthesia. Subsequently, when relaxation had occurred, the mass was very much smaller, and now lay in the right lower quadrant, undoubtedly the result of a partial reduction of the intussusception. This was about 10 cm. long and was easily reduced by pressure on the distal part until about one-half remained. Traction completed the reduction. It was then discovered that the intussusception was caused by an inverted Meckel's diverticulum which was very much indurated. This was everted; resection was decided against as too risky a procedure, and the abdomen was closed in layers without drainage. The patient made an uneventful recovery and was discharged the tenth post-operative day. He was last seen six years later at which time it was learned that he had been in excellent health.

Diagnosis.—Ileocolic intussusception with a Meckel's diverticulum.

Comment.—The roentgen findings are fairly typical for invagination; *i.e.*, obstruction, filling defect due to an intraluminal mass with its convex presenting surface, and cup-like depression in its center. The U-shaped configuration of the barium, emphasized by many authors, is not well shown on the film.

CASE 7

C. Mc., a 32-year-old truck driver, had been well until ten months previously when he experienced cramping low abdominal pain, usually after a bowel movement. One month later the pain became more frequent, almost daily in occurrence, and more severe. The patient's appetite gradually failed and he lost 15 pounds. Six weeks before admission he experienced his most severe bout of pain, lasting several hours. His stools had been normal in ap-

pearance. The clinical impression was that of an intracolonic neoplasm, and the patient was admitted to the hospital two days later for a more complete study. At this time, the lower abdomen was dis-

up toward the hepatic flexure, there was a rounded filling defect in the tip of the cecum, and the hepatic flexure was dilated by an intraluminal mass. After injection of air in double-contrast studies, barium



Fig. 6.

Fig. 6. Case 7. Post-evacuation film demonstrating the intussusception in the proximal transverse colon. Barium is present between the stretched plicae. The terminal ileum is filled.

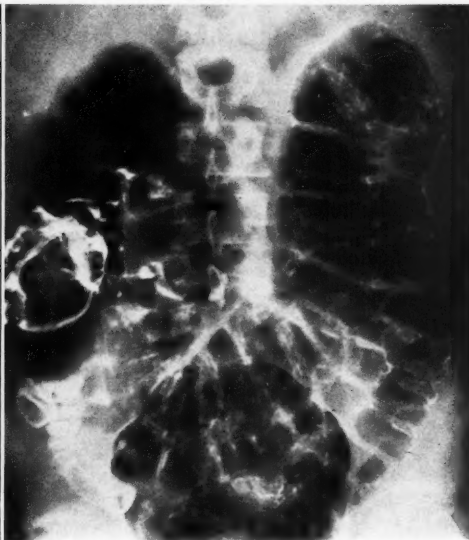


Fig. 7.

Fig. 7. Case 7. Double-contrast film demonstrating the carcinoma of the cecum. The pressure of the air has been sufficient to completely reduce the intussusception.

tended and tympanic. The ascending colon was palpable. Routine laboratory studies disclosed a moderate secondary anemia. Three out of 12 stool examinations gave positive benzidin reactions. On proctoscopic examination 14 cm. of rectum and sigmoid were visualized, and they presented a normal appearance. Detailed roentgen studies were made. The gall bladder, esophagus, stomach, and duodenal bulb were normal. With a barium enema the colon was observed to be redundant, and there was difficulty in filling the bowel beyond the hepatic flexure. The barium outlined an oval, palpable, but non-moldable mass. A film of the filled colon showed no lesion. A post-evacuation film excellently demonstrated the mucosal pattern of the colon. The cecum was drawn

again outlined a mass in the cecum, measuring about 6 cm. in diameter. There was barium in the terminal ileum. At a repeat colon fluoroscopy, the rectum and sigmoid filled easily. After the column of barium reached the splenic flexure, it met an obstruction which presented an oval appearance, convexly pointing toward the distal colon. As the enema was administered, this obstruction advanced proximally and the colon ballooned in a normal manner distal to the mass. As the barium reached the hepatic flexure, the colon filled with difficulty, but eventually barium passed the hepatic flexure. With the patient on his side, a definite area of decreased density surrounded by barium could be seen, measuring approximately 10 cm. in diameter. The mass noted previously in the

cecum could neither be palpated nor visualized. Apparently the intussusception was being reduced by the action of the enema. A post-evacuation film demonstrated a normal mucosal pattern of the ascending,

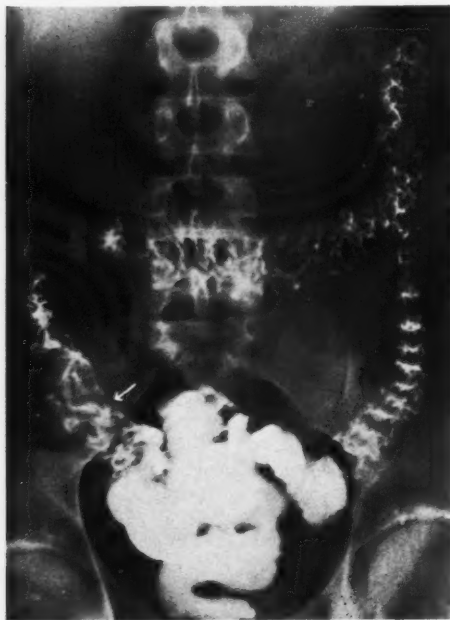


Fig. 8. Case 7. Post-evacuation films after the second examination. The intussusception has been completely reduced. The mucosal pattern of the lower ascending colon is distinctly abnormal. The carcinoma of the cecum is obscured by the filled terminal ileum.

transverse, and descending colon. The mucosal pattern in the cecum suggested edema, possibly also tumor infiltration. A double contrast film, after injection of air, yielded similar findings. There was no evidence of an intraluminal mass. These roentgen studies indicated severe intussusception of the cecum and ascending colon into the transverse colon, caused by an intraluminal mass, and recurring frequently. Administration of an enema served to overcome the distal part of the intussusception.

While being prepared for surgery the patient suddenly experienced a severe cramping pain with a bowel movement.

There was an abrupt descent of bowel through the anus for a distance of 15 cm. In the prolapsed bowel, a hard, irregular mass 6 cm. in diameter was discovered. Edema became very pronounced and the prolapse could not be reduced. The mass was excised under spinal anesthesia. The patient did not rally from the operation and died several days later. At autopsy it was learned that the terminal ileum, cecum, and ascending colon had invaginated into the transverse, descending, and sigmoid colon, and that the prolapsed bowel was cecum. Death resulted from obstruction with gangrene, perforation of the splenic flexure of the colon, and generalized peritonitis.

Diagnosis.—Intussusception of the terminal ileum, cecum, and ascending colon into the transverse, descending, and sigmoid bowel, with prolapse through the anus of 15 cm. of cecum containing a carcinoma.

Comment.—This case presented the most positive roentgen evidence of intussusception of the entire series: (1) Obstruction to the barium enema; (2) mobility of the obstruction under manipulation; (3) filling defect at site of obstruction; (4) palpable mass; (5) the passage of barium between the intussusceptum and intussusciens, outlining the "head" of the invagination.

The mucosal pattern of the cecum is interesting. It is difficult to state whether the appearance is due to edema (the result of irritation), or to tumor infiltration. Prolapse of an intussusception through the anus is not rare. In the monograph by Perrin and Lindsay it is stated that this occurred in 39.6 per cent of 400 cases. Many others have reported similar cases.

SUMMARY

A review of the literature on the roentgen diagnosis of intussusception has been presented. Seven additional cases have been described, illustrating various phases of the roentgen diagnosis. In all but one case, the intussusception was of the ileocolic type.

CONCLUSIONS

1. The most frequently described roentgen signs of invagination are:
 - (a) Obstruction to the barium enema with a filling defect.
 - (b) Mobility of the obstruction under manipulation.
 - (c) Palpable mass.
 - (d) Passage of barium between the intussusceptum and intussusciptions.
2. The x-ray examination is a definite aid in the diagnosis of intussusception involving the large bowel.

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EFFECT OF TREATMENT OF BRAIN TUMORS WITH ROENTGEN RAYS¹

REVIEW OF UNIVERSITY HOSPITAL CASES

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INTRODUCTION

A CONSIDERABLE amount of work has been done within the last ten years in an attempt to correlate the responses which have been observed in the irradiation of brain tumors. At present a variation of opinion is prevalent concerning the value of x-ray therapy in these conditions. Apparently good results following x-ray therapy have been questioned because of the known variation in the survival periods of the various types of brain tumors, because of known remissions and exacerbations in untreated cases, particularly the astrocytomas, and because it is difficult to say how much of the improvement was due to preceding surgery and how much to irradiation. The early papers on this subject attempted to interpret the value of irradiation therapy in the light of the clinical improvement observed, but because of the above-mentioned difficulties and the personal element involved, the investigations of the last ten years have been concerned chiefly with changes in the histopathologic picture of the various tumor types following x-ray therapy. This method of approach has been utilized by Davis and Weil (6), Deery (7), Frazier, Alpers, Pendergrass, and Chamberlin (11), O'Connell and Brunschwig (14), Alpers and Pancoast (1), Bailey, Sosman, and Van Dessel (2), and others.

The above-mentioned studies employed biopsy material obtained previous to x-ray therapy and that obtained at a later operation or at autopsy, for a purpose of comparison. The main histopathologic changes have been a reduction in cellularity of the neoplastic mass, an increase

in the amount of fibrous tissue and eventually fibrous replacement, a reduction in the total number of mitotic figures, and occasionally the appearance or increase in the number of giant cell forms. There is also a variable amount of vessel thickening which is considered by some as an essential feature and by others as a secondary change following irradiation.

Studied by this method Davis and Weil (6) found that medulloblastomas showed very little change, whereas Frazier, Alpers, Pendergrass, and Chamberlin (11) found a marked change. Clinically, this type usually shows marked improvement. These histologic variations may possibly be explained by the fact that the time intervals between irradiation and biopsy varied considerably. If the time were long enough a newgrowth arising from tumor remnants might conceivably mask a previous regression.

Spongioblastoma multiforme (glioblastoma multiforme) usually exhibit rather marked clinical improvement for a time. Sachs, Rubinstein, and Arneson (16) state that the average survival period for this group is from 10 to 14 months, if surgery alone is employed, and they present three cases which were given irradiation and survived for an average of 24 months. In the histopathologic studies it is very difficult to evaluate effects due to irradiation in spongioblastoma multiforme, as the structure of the neoplasm varies so markedly in different portions of the growth, and because the tumor during development may undergo changes similar to those which might be attributed to irradiation. Of six astrocytomas reported by Frazier, Alpers, Pendergrass, and Chamberlin (11) there was a very definite change noted in three. Of the three re-

¹ Read before the Minnesota Branch of the American Society of Cancer Research, Dec. 23, 1937.

maining cases which showed no change, only one had adequate treatment which these authors believe to be a tumor dose of over 2,000 r given at the rate of 200 r daily.

Reports have quite uniformly shown that ependymomas exhibit a marked histopathologic change together with good clinical improvement. Oligodendrogliomas show little or no histopathologic change, and there has been no recorded clinical improvement in this type except for one case reported by Sachs, Rubinstein, and Arneson (16).

Many workers have stated that there is no correlation between the amount of x-ray therapy given and the histological response observed. This is no doubt due to the fact that there has been such a great variation in the methods of treatment. As Frazier, Alpers, Pendergrass, and Chamberlin (11) pointed out, the correlation has been found to be high when the last series before biopsy or necropsy was considered instead of the total dose. While it is perhaps true that future advances in the treatment of cerebral neoplasms will probably come from histopathologic studies, the factors used in the different clinics have varied so widely up to the present that attempts to correlate separate reports would be futile. To make future studies of value all steps in treatment must be carefully standardized. As Deery (7) suggests, there must be—(1) Exact description of the location and size of the tumor; (2) exact statements as to the operative procedure; (3) standardization of pathologists' evaluation of malignancy; (4) general acceptance of adequate dosage and technic.

DISCUSSION

In a group of cases which have been reviewed at the University Hospital there has been no attempt to study the microscopic response since there were too few which had biopsies before and after irradiation, and in these the intervals differed considerably between the time of biopsy and

the time of irradiation; also, a considerable number of the biopsies were done elsewhere so that the tissue was not available for study here. We have tried to determine whether the favorable response obtained clinically in certain patients could be attributed wholly or chiefly to irradiation. We have not attempted to draw any conclusions from the series but merely present it to show the general response which has been observed in this clinic.

Treatment factors were as follows: 200 kv. peak voltage; 30 ma. current; filter 1 mm. Cu plus 1 mm. Al; 60 cm. T.S.D.; 10×10 cm. fields; half value layer 1.3 mm. Cu; output 27.2 r/min. measured in air. We have been giving 350 r every other day to one portal. Irradiation is given through from two to four portals depending on the location of the lesion until a total dose of 2,400 r has been given. This occasionally has been repeated up to five times, at two- to three-month intervals. Of the 44 cases to be described, 25 received but one course, and 12, two courses. Recently we have begun to give daily treatments of 160 r using the above factors and giving a total dose of 5,000 r over 27 days. This change has been instituted too recently to permit us to draw any conclusions from the results of this technic.

In the past ten years 74 patients have been treated in this therapy department, but only 68 could be checked as to their subsequent course. Of this number the diagnosis was proved by biopsy or necropsy in 44 cases. The median age for this group was 33 and the ratio of males to females was 2:1.

Of the 44 patients arranged in Table I, six, represented by the minus signs, died during or soon after treatment; since there was no time interval here in which improvement might have been observed, these were excluded from the discussion. It might seem that death was caused or hastened by irradiation in these cases. This was, for the reasons stated below, apparently not true. O'Connell and Brunschwig (14) state that there are two types of death which have been attributed to x-ray

therapy. The first is due to increased pressure where no preceding surgery has been done and in which the symptoms appear

TABLE I.—TUMORS OF CEREBRUM, CEREBELLUM, AND MENINGES; VERIFIED BY BIOPSY OR AUTOPSY

(Arranged according to the classification by Cushing, 3)

		Im- proved	Dead	Autopsy
1. Gliomas				
Astrocytomas	13			
Fibular	2	0	2	1
Cellular	3-1	2	3	1
Cystic	1	1	0	0
Undifferentiated	7-2	5	6	1
Spong. multiforme	6	6	6	1
Medulloblastomas	1	1	1	0
Indeterminate type	5	3	3	2
Oligodendroglioma	1	1	0	0
Ganglion neuroma	1	0	0	0
2. Pituitary adenomas	Not included in this series			
3. Meningiomas	5-1	3	4	3
4. Acoustic tumors	1	0	1	0
5. Congenital tumors				
Teratoma	1	0	1	1
6. Metastatic and invasive tumors				
Melanoma	1	0	1	1
Sarcoma	1-1	0	1	1
Neurocytoma	1	0	1	1
Metastatic malign. or hemangio-endothelioma	1	1	1	0
7. Granulomatous tumors				
Tuberculoma	1	0	1	1
8. Blood vessel tumors				
Endothelioma	1	1	1	0
Angioblastoma	1	1	0	0
9. Primary sarcoma	0	0	0	0
10. Papilloma	1-1	0	1	1
11. Miscellaneous localized encephalitis	2	1	1	0
	44-6	25	35	15
	38			

(according to Bécélère) in one-half hour following treatment. The second type is preceded by no sign of increased pressure; the decompression remains soft and even flat or sunken. Such patients become listless, anorexic, and anemic. They gradually fail, and finally die in a cachectic state. In the above six cases, however, there was a preceding decompression performed in all but one; this latter patient was in a moribund state when treated and was treated only at the insistence of the surgical staff. Only part of the treatment was given and there were no following changes which might be attributed to a

sudden increase of pressure caused by irradiation. Of the remaining five patients, three died shortly from meningitis induced by preceding surgery. Regarding the second type of death without signs of increased pressure, there is no reason to believe that this might not also have occurred without roentgen treatment. One patient, not treated by x-ray therapy, went to just such a death six weeks after a preceding surgical excision which had been followed by temporary recovery. Further, it has been shown by Davis and Weil (6) that very little change has been noted in normal brain tissue following therapy for adjacent malignancies. Davis and Cutler (5) found that necrosis around radium needles implanted in canine cerebrums was limited to the areas immediately next to the needles and that this was not appreciably greater than the necrosis found around needles not containing radium element. Demel (8) produced deficient growth of the entire body, ataxia, and small hydrocephalic brains, in four-day-old puppies with irradiation of the brain, but Scholz (17) concludes that the brains of adult animals will withstand very high doses of x-ray. Elsberg, Davidoff, and Dyke (10) gave varying single doses to the brains and spinal cords of *Macacus rhesus* monkeys and concluded that any dose below 3,000 r was safe. In treatment of the human brain Sachs, Moore, and Furlow (15) have given as high as 6,000 r of unfiltered radiation directly to the brain through a craniotomy wound without noting untoward subsequent effects. Because of these reasons, x-ray therapy probably should not be blamed for the six above-mentioned fatalities in the series under discussion.

There was improvement of varying degree and for varying periods of time in 25 of the 38 remaining cases. It is evident, of course, that of the 25 histologically proved cases showing improvement it could not be determined whether the clinical gain should be credited definitely to surgery, irradiation, or to both. For that reason, certain cases have been grouped according to the surgery which was done in order to show

those in which the improvement was apparently due chiefly, or entirely, to roentgen therapy. The degree of improvement is self-explanatory: (1) refers to fair improvement, (2) to moderate improvement, and (3) to marked improvement, with nearly complete regression of symptoms.

The following cases are presented merely to illustrate the interpretation of such improvement.

Case 1. Degree 1. This patient was a white female, aged 37, with complaints dating from August, 1931, at which time she noted a definite decrease in her visual acuity. This progressed to complete loss of vision in June, 1932. During this time she had occasional attacks of vertigo and moderate frontal headaches.

She was admitted to the University Hospital on July 28, 1932. The pertinent physical findings at that time were bilateral optic atrophy with complete loss of vision, bilateral exophthalmos which was more pronounced on the left, and dilated pupils of equal degree. Blood and urine examinations were normal. The spinal fluid was under pressure of 350 mm. water, but was negative to examination. X-ray films of the skull showed destruction of the posterior clinoids which was interpreted as being due to an extrasellar neoplasm. Because of the complete loss of vision surgery was deferred and x-ray therapy given. This consisted of 940 r given to each of two fields in four treatments over a period of seven days. The patient was discharged Aug. 25, 1932.

Following treatment there was a temporary increase in the severity of the headaches and vertigo. This soon disappeared however, and for the next four years these symptoms were entirely absent. Her blindness was permanent, of course, but she stated that she generally felt much better following irradiation therapy. She worked daily and gained 40 pounds during the year following discharge.

In July, 1936, she experienced a sudden attack of convulsions and loss of consciousness. She recovered from this within a few minutes but in September developed

pain in the eyeballs and severe frontal headaches. On Sept. 17, 1936, she became comatose and was admitted to the hospital in this condition. Surgery was refused by the patient's family and x-ray therapy was begun as a last resort. She failed to rally, and died before the series was completed. An autopsy was obtained and revealed an extensive meningioma beneath both frontal lobes.

Case 2. Degree 2. This patient, a white male, aged 43, was admitted to the University Hospital on Feb. 24, 1932. He gave a history of irritability and headaches for three months, emesis for one and one-half months, constipation for one and one-half months, diplopia for three weeks, and a weight loss of 15 pounds in three months. Physical examination showed a somnolent individual who was mentally dull and who could not understand simple questions. There was a marked loss of memory, especially for recent events. The right pupil was larger than the left, and the left was sluggish to light. The disks showed bilateral choking and there were numerous punctate hemorrhages in both fundi. Definite paresis was exhibited in the right upper extremity and a loss of stereognostic sense was noted in both hands. The patient had an unsteady gait and the tendon reflexes were more prompt on the right side of the body.

A ventriculogram was done March 4 but was unsatisfactory. Following this procedure he was continuously comatose up to the time of operation on March 9. At that time a large tumor was found in the left frontal lobe which was resected as completely as possible. Microscopic section showed it to be a spongioblastoma multiforme. He was treated with x-ray on recovery from the surgical procedure and was given 650 r to each of two fields in four treatments. At the time of discharge on March 30 the findings were about the same as on admission.

An additional 550 r was given to each of two fields in April. On May 27, 1932, he was seen in the out-patient clinic. At that time he was feeling in excellent general

health. His mentality was clear, and his memory was perfectly normal. The eye grounds showed only one-half diopter choke on the right and one diopter on the left. There was only questionable slight paresis of the muscles innervated by the right fifth, eleventh, and twelfth cranial nerves. The patient could write without difficulty and the grip was equal in both hands. He was free from headaches and walked in a normal manner.

About the first of July he developed a partial aphonia and the right arm and leg became definitely weaker: 900 r were given to each of three fields with only slight improvement. The patient became progressively worse and died one month later.

Case 3. Degree 3. This patient, white male, aged 40, was first seen here in the dispensary in July, 1932, with a gastro-intestinal complaint which was diagnosed and treated as duodenal ulcer; at that time he stated that he had been having headaches in the supra-orbital region off and on for 18 months.

In the Fall of 1932 he began to complain of impaired vision and photophobia and increasingly severe headaches. His wife noted that his memory was becoming very bad. On October 6 he suddenly became comatose and was taken to the Mayo Clinic. At that time general and neurologic examinations revealed no positive findings except bilateral choked disks of two diopters and a partial third nerve palsy on the left side. The impression obtained clinically and from the ventriculogram was that he was suffering from a rapidly growing, deep-seated tumor. He was given a course of x-ray therapy and discharged from the Mayo Clinic much improved. He returned for examination in January, 1933, and was in excellent condition except for a bitemporal hemianopsia and only occasional slight headache.

He was admitted to this hospital on May 10, 1933, complaining of recurring headache, impaired vision, and paresthesias of his right arm. Neurologic examination showed a bitemporal hemianopsia and constriction of the nasal fields. The visual

acuity was $\frac{3}{10}$ in the right eye and $\frac{6}{10}$ in the left eye. There was a secondary bilateral optic atrophy and moderate external strabismus and limitation of conjugate movements upward. There was a moderate degree of deafness bilaterally, air conduction being greater than bone conduction. X-ray examination of the skull showed the trephine openings made during the previous ventriculography procedure, the floor of the sella turcica was markedly depressed, and the posterior clinoid processes were almost completely eroded. X-ray examination of the gastro-intestinal tract was negative. Diagnosis rested between an intrasellar or an extrasellar tumor. The patient was told that if his eyesight became worse operation might be attempted. He was re-admitted July 5 complaining of very severe headaches and requesting operation. Exploratory craniotomy was performed on July 15, at which time a soft, diffuse tumor mass was found arising from the right optic nerve. Biopsy alone was done and closure was effected. Subsequent microscopic examination showed the tumor tissue to be from an astrocytoma. He recovered satisfactorily from the operation and was given 850 r to each of three fields. He returned and was given a similar series beginning Oct. 30, 1933. At that time he was very much improved; his eyesight was better, there were no headaches, and he was able to be up and around most of the time.

On Jan. 18, 1934, he was seen in clinic. He was then feeling much better, was able to read the newspaper, and was working daily. In September, examination showed only slight constriction of the visual fields. There were only occasional slight headaches, and the memory was much improved. His next visit to the out-patient department was in September, 1935. At that time there was again noted marked improvement; his memory seemed normal, and he was working daily on his farm. He was again seen in March, 1936, at which time he was entirely symptom-free; visual acuity was $\frac{20}{30}$ in the right eye and $\frac{20}{30}$ plus 3 in the left; the fundi were normal

except for slight haziness at the nasal margins.

He continued to be neurologically negative for the next year and a half. He was admitted to the hospital on Sept. 16, 1937, with an abdominal complaint which examination showed to be due to a ureteral stone on the right side. Ophthalmoscopic and neurologic examinations revealed nothing abnormal. A ureterolithotomy was done Sept. 21, 1937, and the patient was discharged on Oct. 5, 1937.

In November, 1937, he was again seen in clinic and complained of bloating and some vomiting. Gall-bladder x-ray examination was negative, and the patient was put on an ulcer régime similar to that which had been employed in 1932.

Table II is self-explanatory except for the four following cases, which merit additional explanation. In the first case no surgery was done; the history and clinical course are described in the case representing first-degree improvement. It seems unusual that a meningioma should respond to irradiation, and such reports are few. However, Dyke (9) states that cases of fibroblastic meningiomas may respond, and de Luca (12) and Nordentoft (13) each reports a case of a meningioma with multiple involvement which responded well for a five-year period following x-ray therapy. There is also a case in our series in which a basal meningioma is suspected clinically, and which showed a very good response following therapy. When first seen, the chief symptom was frontal headache and disturbance of vision due to a marked unilateral exophthalmos. X-ray of the skull showed hyperostosis of the lesser wing of the sphenoid which was interpreted as due to an adjacent meningioma. The patient refused surgery and she is still living and in good condition, 40 months after irradiation therapy. The one patient in the third group, where x-ray therapy was given before surgery, showed marked improvement. In the fourth group, where decompression and biopsy alone were done because of apparent inoperability of the lesions, the first starred case represents a

patient who received a course of irradiation treatment before surgery was performed. There was about a second-degree

TABLE II.—CEREBRAL TUMORS PROVED BY AUTOPSY OR BIOPSY

Type	No. Improved	No. Dead after Treatment	No. Mos. to Death or Living after Treatment
1. No surgery			
Meningioma	36	1	D 51
2. Trephine only for Ventriculography			
Astrocytoma	24	2	L 27
3. X-ray before surgery			
Hemangio - endothelioma or met. malignancy	6	2	D 7
4. Decompression and biopsy only			
Spong. multiforme	5	2	D 9*
Spong. multiforme	3	3	D 4
Spong. multiforme	2	1	D 3
Glioma; indet. type	28	3	L 28
Astrocytoma	61	3	L 61*
Astrocytoma	8	1	D 26
Astrocytoma	25	2	D 32
Local encephalitis	10	1	L 46

improvement for a period of two months. At the end of this time a recurrence developed and surgery was done. The decompression procedure and another series of x-ray treatments were followed by similar improvement for an additional three months. The second starred case represents the patient described in the example for a third-degree improvement. In this patient there was marked regression of symptoms following irradiation before any surgery had been performed.

Twenty-one patients in whom the diagnosis of cerebral neoplasm was entirely clinical, were treated in this clinic. These are also arranged in groups in Table III to show possible clinical benefit from irradiation.

Table III is self-explanatory. The second patient in the second group was improved up to the time of death, which was caused by pneumonia.

There have been only six cases of proved cerebellar and four clinical cerebellar tumor cases treated here.

Of the six cases of proved cerebellar tumors, two died during, or immediately after treatment, and one died one month

after therapy without improvement. As in the cerebral tumors, there was no reason to believe that irradiation was a contribut-

It is better to represent the two cases starred in the clinical brain tumor group separately in Table V, since they may not

TABLE III.—CLINICAL CEREBRAL TUMORS

Position	No. Mos. to Death or Months Living after Rad.		
	Improve- ment No. De- Mos. gree	ment No. De- Mos. gree	or Months Living after Rad.
1. Cases positive clinically, by skull plate and by ventriculography, no surgery performed			
Rt. ant. corpus callosum	71	3	L 71 $\frac{1}{2}$
Rt. frontal	2	1	L 18
2. Cases positive clinically, skull plate non-localizing, no surgery, no ventriculography			
Rt. frontal	72	3	L 72*
Basal lesion	44	2	D 44
Mesencephalon	6	1	D 9
Left third ventricle	7	2	L 10
3. Surgery consisting of decompression and exploration, ventriculography positive in 1, 3, and 4			
Left third ventricle	4	2	D 37
Rt. frontal	1	1	D 5
Rt. temporal	1	1	D 3
Rt. parietal	2	1	D 6
Left frontal	1	1	D 2
Pontine	18	3	L 18*

* This case is now believed to be a cyst of the septum pellucidum.

TABLE IV.—CEREBELLAR TUMORS

Type	No. Mos. to Death or Months Living after Treatment		
	Improve- ment No. De- Mos. gree	ment No. De- Mos. gree	or Months Living after Treatment
1. Those proved by biopsy			
(A) Decompression plus exploration			
Glioma; type indet.	95	2-3	D 95
(B) Decompression plus resection			
Glioma; type indet.	3		Not Followed
Medulloblastoma with spinal metastases	12-20	3	D 20-24
2. Clinical cerebellar tumors			
(A) Decompression plus exploration			
Case 1	7	2-3	D 10
Case 2	45	2	D 45
Case 3	56	3	L 56

ing cause of death. The patient in Division A of the first group was improved up to death, this being caused by carcinoma of the rectum. Of the four cases of clinical cerebellar tumors, one was a very questionable diagnosis (no surgery was performed), and the patient died two months after x-ray therapy without improvement. The third patient in the second group is now ten years old, is apparently completely well, and is attending school.

TABLE V

Position	Age	Clin.	Plain Film	Mos. Im- Sur- Vent. proved gery		
				None	72	0
Rt. Frontal	47	Pos.	Incr. Pr.	Normal	18	D-E
Pontine	24	Pos.	Incr. Pr.	Normal	18	D-E

be true cerebral neoplasms. They seem to belong to the type of cases which Dandy (4) has recently described as "intracranial pressure without brain tumor."

It will be noted that in both cases (Table V), the diagnosis was positive clinically. The plain film of the skull showed signs of increased pressure without localization. A ventriculogram was not done in one and in the other was entirely normal. Both showed marked improvement and are living at present, 72 and 18 months after treatment. No surgery was done in the first and only a decompression was done in the second. Dandy (4) has reported 22 cases in which a clinical diagnosis of brain tumor was made which was not substantiated by ventriculography. All of these patients had symptoms indicating an increase of intracranial pressure. In each case this pressure had been demonstrated and measured by ventricular or lumbar puncture. All plain films of the skull in his cases showed signs of increased intracranial pressure without localizing signs of tumor, and ventriculography in all revealed a normal ventricular system. Four cases in which the symptoms were minor were merely observed, and no treatment instituted. These four gradually improved without treatment and may correspond to the first of the two cases in Table V. Dandy's report is particularly interesting since it is evident that a certain number of brain tumors which have been diagnosed clinically but never verified by biopsy or autopsy may fall into this group where the symptoms and signs are an expression of pathologic conditions and not of brain tumors. It is possible,

therefore, that x-ray therapy was not a factor in the improvement in these cases.

SUMMARY

Fifteen of the 24 brain tumors diagnosed clinically showed improvement for periods varying from one to 72 months. It is quite possible that all 15 were aided by irradiation. Unfortunately this cannot be verified. However, it is quite certain that improvement in nine of the 15 was due chiefly to x-ray therapy. If the two cases discussed under intracranial pressure without brain tumor are excluded, the above number is reduced to seven; five of the seven showed either second- or third-degree improvement.

Twenty-five of the 38 brain tumors proved by biopsy or autopsy showed clinical improvement. As in the group diagnosed clinically it is likely that irradiation played a rôle in all 25 although this cannot be ascertained. There seems to be fairly definite evidence, however, that the improvement in nine of the 25 should be attributed chiefly or entirely to x-ray therapy. Of these nine, six showed either second- or third-degree improvement and four of this number are still living.

It is evident then that, regardless of the controversies regarding the value of x-ray therapy in the treatment of brain tumors, there are certain cases in which remarkable responses are obtained following its application, and presumably due to its effect. At present it is the opinion in this department that the dosage used in cases of brain tumor should be materially increased. Recently we have begun giving fractionated daily doses over a period of a month, resulting in a total dose of 5,000 r. Until the results from more intensive irradiation have been tabulated it will be difficult to predict the results.

This group of cases has been accumulated over a ten-year period and was not treated by the author. The records were perused by myself at the suggestion of Dr.

Wilhelm Stenstrom, who, together with William Peyton, M.D., kindly tendered much useful advice. The biopsies which were taken here were examined by either E. T. Bell, M.D., William O'Brien, M.D., or R. W. Koucky, M.D., and the surgery performed by William Peyton, M.D.

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ROENTGEN DIAGNOSIS OF PREGNANCY¹

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ATTEMPTS to employ roentgen rays in obstetrical diagnosis ensued almost immediately upon announcement of the discovery by Roentgen in 1895. At the outset, all efforts to secure roentgenographs of living fetuses invariably resulted in failure. However, coincidentally with progressive improvement in apparatus and consequent refinement of technic, chiefly by Albers-Schönberg in 1904 (1), Thoms in 1922 (16), Bouchacourt in 1923 (2), and Jungmann in 1927 (9), the application of roentgenology to obstetrics became general, presumably because of the recognition of its value as a source of accurate and dependable information in comparison to that supplied by ordinary methods.

Credit for the original demonstration of a fetal shadow by means of a roentgenogram is variously attributed to Levy-Dorn (10) and Müllerheim (11), who reported the results of their experiments a few months apart in 1897 and 1898, respectively.

Probably Warnekros (17) was the first investigator to succeed in obtaining roentgenograms of the living fetus during labor. His observations published in 1917 and 1918, subsequently served as a guide for his successors in their studies of the position of the fetus at the various stages of parturition.

For a long time it was feared that injury to fetus or mother might result from exposure to roentgen rays (4). This apprehension was fostered by accounts of post-radiative fetal and maternal injuries ranging from infantile alopecias to teratoses, and from still births to abortions. It was afterwards discovered that in these cases the radiation was therapeutic rather than diagnostic, and was applied in com-

paratively large doses for the treatment of conditions ranging from simple menorrhagia to cancer of the cervix. Actually, there is not the slightest evidence that antenatal exposure to roentgen rays for purposes of diagnosis is at all harmful to the fetus or mother.

In his excellent monograph on roentgenography as an aid in obstetrical diagnosis published in 1931, Jarcho (8) presented a survey of the literature to that date. This showed that among 95 cases of suspected pregnancy subjected to roentgenographic examination, 61 reported by Warnekros and 34 reported by Dijol and Michelin, the presence of a fetus was clearly demonstrated in 64 cases in the fourteenth to the twentieth week of pregnancy, while in 31 cases no fetal skeleton was visualized. The literature to 1931 revealed 15 cases of anencephalus diagnosed roentgenographically.

Roberts (12), in 1932, related his experience with 600 cases in which a roentgen examination was undertaken at the request of an obstetrician, either because of clinical suspicion of abnormality, or to supplement ordinary methods of examination. In his series, twins were demonstrated in 84 cases, and triplets in one instance. Of three cases of extra-uterine pregnancy included in the series, two were diagnosed roentgenologically. Anencephalus was shown in 17 cases, hydrocephalus in six, iniencephalus in three, meningocele in one, and rudimentary upper limbs in one. Of 16 cases of intra-uterine death involved in the series, Spalding's (14) sign was positive at the first roentgen examination, in nine cases.

Unlike the Aschheim-Zondek and other analogous tests for pregnancy which require several days (from 96 to 100 hours) for their effective application, and even then afford only presumptive evidence,

¹ Read before the Washington Gynecological Society, March 26, 1938 (by invitation).

roentgenography renders possible an immediate positive opinion as to the existence or non-existence of pregnancy. In addition, it facilitates the differential diagnosis between the latter condition and hydatidiform moles and abdominal and pelvic tumors in obscure cases, and determines the position and presentation of the fetus when there is doubt concerning these aspects. In still other instances, roentgenography permits a decision as to the presence of more than one fetus, and the possibility of extra-uterine pregnancy. Again, it provides an opportunity for the investigation of the cause of hydramnios, with particular reference to fetal abnormalities, serves for the detection of placenta prævia, and aids in the diagnosis of intra-uterine death. Finally, it enables the assessment by means of pelvimetry of the precise measurements of the pelvic brim or outlet in a case of suspected contracted pelvis, and the verification of suspected disproportion between the fetal head and the maternal pelvis.

In certain cases previously reported with clinical findings markedly indicative of fibroids and other conditions simulating pregnancy, a positive diagnosis of pregnancy was established by roentgenography, and an unnecessary hysterectomy was thus avoided.

Roentgenographs in two planes (antero-posterior or postero-anterior, and lateral) invariably furnish precise and reliable information concerning the presenting part, and the relation of the fetal parts to each other and to the maternal pelvis and spine, thereby enabling the estimation of the degree of flexion of the head in vertex presentations, and of flexion or extension of the lower limbs in breech presentations.

In cases of multiple pregnancy, roentgenographs disclose the relative position of the fetuses to one another and to the maternal parts. Twins may often be demonstrated roentgenologically, even when undetected by previous clinical examination. Also, in hydramnios, when a tentative diagnosis of multiple pregnancy

has been made clinically, the presence of only one fetus is frequently shown.

Extra-uterine pregnancy is revealed whenever any of the fetal parts are observed to extend beyond the shadow of the uterus. If the latter is not demonstrable in suspected extra-uterine pregnancy, uterosalpingography may be resorted to by injecting lipiodol into the uterine cavity and taking a roentgenograph. The shape of the filled cavity and its relation to the fetal shadows will afford the desired information concerning the extra- or intra-uterine site of the pregnancy. However, if this procedure is elected, there should be the closest co-operation between the roentgenologist and the obstetrician, since only the latter can determine whether the use of the method is warranted; and termination of a pregnancy without sufficient indication is a reprehensible act.

Uroselectan is employed as a contrast medium in amniography when the latter is utilized for the discovery of a placenta prævia. The substance is injected through the abdomen into the amniotic sac, following the withdrawal of an equivalent quantity of amniotic fluid. The use of uroselectan is open to objection from the clinical point of view by reason of the fact that its injection inevitably results in the termination of pregnancy. Another method for the same purpose, applicable only in the latter months of pregnancy and to vertex presentations, consists of visualization of the bladder after filling it with 12.5 per cent solution of sodium iodide—the translucent interval between the fundus of the bladder and the fetus appears greater than normal in placenta prævia. Cystography is simple, safe, and involves no risk of abortion, but it is inapplicable to cases of lateral and posterior placenta prævia, since the presence of a central clot often entails misinterpretation of the roentgenographs.

Intra-uterine death is indicated by the roentgenological sign originally described by Spalding (14), characterized by collapse of the vault, which in turn, results from shrinkage of the brain and produces

overlapping of the cranial bones. This phenomenon should be carefully differentiated from the normal overriding or molding which occurs during labor.

In his recent masterly article on roent-



Fig. 1. Early pregnancy. Duration 61 days or less.

genography in obstetrics, Jacobs (7) presented a most complete description and sound evaluation of the several methods of roentgen pelvimetry; hence their consideration and the discussion of their respective merits need not detain us here.

Although absolute measurements of both the maternal pelvis and the fetal head constitute our objective, that of the former are by far the more important, since it should ever be borne in mind that the birth canal is a tortuous fixed passage, while the fetus is an adaptable passenger. However, by means of roentgenographs taken in the postero-anterior, antero-posterior, and lateral projections, a fair idea of the allowance for relative enlargement of the skull and pelvis due to their different distances from the films may be obtained.

The roentgenologist has at his disposal two criteria on which to base an estimate of the duration of the period of gestation and the corresponding age of the fetus; namely, the size of the fetus, and the stage

of ossification of its bones. Since the size of the fetus varies with the target-fetus-film distance, a standard technic should be maintained for the establishment of a standard of comparison of sizes of fetuses at different ages. Unless this distance is known, the size of the fetus cannot be gauged from the size of the image on the film. Even so, under the most favorable conditions different parts of the fetus will be situated at varying distances, consequently an accurate orientation is impossible. In addition to the roentgenographic size of the fetus, other factors (hydramnios or multiple pregnancy, for example) which may affect its relative distance from the film and the resultant enlargement of its roentgenographic shadow, should be considered.

The method of the determination of the stages of ossification is likewise unreliable, inasmuch as the dates of appearances of the various osteogenic centers are not precisely fixed. Embryological studies show that from the thirtieth day of fetal life osseous centers begin to appear, at first with marked constancy and predilection in certain bones, and shortly afterward they are observed everywhere in the cartilaginous structure of the fetus.

Initial points of ossification appear in the inferior margin of the mandible (Meckel's cartilage), and in the diaphysis of the clavicle from the thirtieth to the thirty-fifth day, and the first cartilaginous islets are invariably noted in these two skeletal sites. Ossification points appear in the tibial diaphysis from the thirty-fifth to the fortieth day, and from the fortieth to the fiftieth day in the frontal (orbital arches), parietal (parietal protuberances), and palatine bone, in the vomer, and at several points in the inferior maxilla (except the symphysis adjacent to the mental foramina, condyles, coronoid apophyses, and the lingula mandibulæ).

Next follow in order the costal diaphyses, the squama and the scapular spine, the humeral diaphyses, the radial diaphysis, the iliac bones, diaphysis of the fibula, and diaphyses of the first phalanges. From

the second to the third month new ossification points appear in the frontal (nasal spine, external orbital apophyses, trochlear fossettes), occipital (basilar apophysis, condyle, squama), temporal (squama, pet-

mass in order to become opaque to roentgen rays. The chronological order of appearance of the different centers is, however, essentially the same with histologic and roentgenologic methods of observa-



Fig. 2.

Fig. 2. Early pregnancy.
Fig. 3. Early pregnancy.

Fig. 3.

Duration 89 days or less.
Duration 90 days or less.

rous, mastoid apophysis), superior maxilla (malar margins, nasal orbit, nasal, palatine, subvomerine), malar bone (zygomatic portion and orbital portion), in bones proper of the nose, the posterior atlantic arch, the epistropheus, the last five cervical vertebrae, the cubital diaphysis, diaphyses of the metacarpal bones, femur, and metatarsal bones.

Finally, during the fourth to the fifth month, ossification points appear in the ethmoid, alae and apophyses of the sphenoid, body and alae of the sacrum, ischium, and calcaneus.

Differences in dates of appearance of centers of ossification from the viewpoint of the roentgenologist, in contrast to that of the histologist and embryologist, are due to the fact that ossification points must have first attained a sufficiently compact

tion. The latter also demonstrates that the clavicle as well as the mandible exhibits the first osseous points revealed by the roentgen rays.

Among pediatricists, Hess (6), who conducted his experiments on fetuses *in vitro*, asserts that initial points of ossification are demonstrable on films as early as the seventh week, while in the eighth week there may be described the appearance of numerous points corresponding to the squamous portion of the occipital bone, superior maxilla, scapular spine, humerus, radius, ulna, femur, and ribs. In the ninth week the metatarsal and metacarpal centers appear, and are followed gradually by centers of ossification of cervical and first dorsal vertebrae, sphenoid, malar bone, other bones of the head, and finally the ilium. In the tenth week there are

found centers of bones proper of the nose, forehead, great wings of the sphenoid, and vertebral arches of the last dorsal and of the lumbar vertebræ. Thus, according to Hess, it may be affirmed that ossification

amnion, and being visualizable normally as early as the fifth week. On the other hand, Grunspan-de Brancas (5) concluded after exhaustive studies that it was extremely difficult to obtain satisfactory



Fig. 4. Early pregnancy. Duration 93 days or less.

of the fetal skeleton has occurred in all its parts by the tenth week, further changes consisting mostly of growth and fusion of centers, and formation of internal structure of bones. Roentgenologists who have studied human fetuses declare that although osseous nuclei exist theoretically in the structure of a fetus of even ten weeks, these foci are so tenuous and diminutive that interposition of a moderately thick layer of muscular, aponeurotic, or adipose tissue is sufficient to prevent clear visibility prior to the tenth week.

Nevertheless, to cite two extremely divergent views, Thomas (15) found that from the sixth to the seventh week of gestation the ovum registered on the film as a semicrescentic area of increased density laterally, and as a circular or oval shadow anteroposteriorly, the opacity being due to the calcium content of the

roentgenological evidence of pregnancy prior to the fifteenth or sixteenth week.

The consensus of opinion on the subject is to the effect that a pregnancy can rarely be visualized successfully before the fourteenth week, but that it should not be excluded roentgenologically until after the sixteenth week, and not then unless at least three roentgenographs have been taken so as to obviate the possibility of non-visualization of the fetal parts through movement that fails to reveal fetal shadows.

According to Thomas (15), from the eighth to the twelfth week, with the embryo in the lateral position, its immature skull appears as a thin-edged broken ring, the annular shadow subsequently exhibiting no broken areas, while the edges gradually become thicker, and the skull and circular shadow increase in size. Small, thin, linear markings shown

by the skull in the anteroposterior and postero-anterior positions grow thicker with the progress of gestation. During the same period the vertebral column reveals positive diagnostic markings resembling a

majority of roentgenologists in the initial stages of pregnancy, the bowels and bladder are emptied, since the presence of urine as well as gas and intestinal contents may produce an accumulation of shadows which



Fig. 5.

Fig. 5. Early pregnancy. Duration 95 days or less.



Fig. 6.

Fig. 6. Collapse of skull vault (Spalding's sign), 31 days, overlapping of anterior fontanelle.

chain of small discrete dots, distributed almost horizontally or slightly curved and arranged like a short string of small beads, which enlarge and thicken, whereupon small lines distributed at right-angles to the dots are visualized. These markings are later shown to be the ribs. Ultimately the extremities may appear as very small, thin, linear, longitudinal markings. By the fifteenth to the seventeenth week the fetus has attained a stage of development in which practically the entire skeleton may be made visible.

Careful preparation of the patient is requisite prior to the fifth month, after which time the fetal skeleton can be shown by almost any technic. In accordance with the procedure preferred by the ma-

will obliterate early fetal skeletal shadows. The patient is placed in the horizontal position with supports under the lumbar spine to accentuate the normal lordotic curve. At least one film should be made with the tube tilted toward the patient's feet, then one ordinary anteroposterior view, and one lateral sacral view. While some authorities recommend marked compression by band or cone in the supine position, others assert that compression promotes fetal movement.

REPORT OF CASES

Case 1. A pregnancy said to be not more than 61 days (Fig. 1).² The last

² Figures 1 to 5, inclusive, have been retouched.

menstrual period, Aug. 20, 1936; contact, Sept. 3, 1936; roentgen study, Nov. 3, 1936. I am not in entire agreement that this case does not exceed 61 days. Repeated interrogation failed to alter the

roentgen study, Sept. 1, 1936. Personal factors in this case insure accuracy of dates. The osseous development is not inconsistent. Position prone.

Case 5. A pregnancy of 95 days or less



Fig. 7.

Fig. 7. Collapse of skull vault (Spalding's sign), six days, overlapping of *anterior* fontanelle.



Fig. 8.

Fig. 8. Collapse of skull vault (Spalding's sign), six days, overlapping of *posterior* fontanelle.

patient's statement regarding dates, concerning which she was definitely positive. (Courtesy J. M. Keichline, M.D.) Position supine.

Case 2. A pregnancy of 89 days or less (Fig. 2). The dates are accurate, and the skeletal development is consistent. The position was prone, with pressure on the buttocks. (Courtesy William J. Corcoran, M.D.)

Case 3. A pregnancy of 90 days' duration or less (Fig. 3). The last menstrual period was March 12, 1936; contact, March 20, 1936; roentgen study, June 18, 1936. The dates are accurate, and fetal development consistent. Position supine.

Case 4. A pregnancy of 93 days or less (Fig. 4). The last menstrual period was May 16, 1936; contact, May 31, 1936;

(Fig. 5). The last menstrual period was Oct. 24, 1936; contact, Nov. 1, 1936; roentgen study, Feb. 27, 1937. The dates are correct. Position prone.

Case 6. Collapse of the skull vault with overlapping at the anterior fontanelle (Spalding's sign of fetal death) is shown in Figure 6. The interesting feature of this case is that studies made at weekly intervals following cessation of fetal movements and heart sounds did not reveal signs of death until the fourth study, made on the thirty-first day. Some days later spontaneous labor ensued, and a markedly macerated and old fetus delivered. Position prone.

Case 7. Collapse of the skull vault with overlapping at the anterior fontanelle six days after the cessation of fetal movements

and fetal heart sounds is shown in Figure 7. The following day spontaneous labor began, and a slightly macerated fetus was delivered. Autopsy of the infant showed a central separation of the placenta which

monster (Fig. 9). The last menstrual period was Dec. 9, 1936. The expected date of confinement was Sept. 16, 1937. Delivered, Aug. 6, 1937. Diagnosis confirmed. Position prone.



Fig. 9. Anencephalus.

was undoubtedly the result of a rather violent fall which immediately preceded the cessation of fetal movements and heart sounds. Position prone.

Case 8. The same case as Case 7, with overlapping at the posterior fontanelle (Fig. 8). Both roentgen studies were made at the same sitting, and the inference is drawn that shrinkage is advanced in the intracranial contents. Position prone.

Case 9. This was an anencephalic

COMMENT

The absolute diagnosis of pregnancy, that is, the demonstration of a recognizable fetal skeleton, can be accomplished routinely from the twelfth week onward, and occasionally earlier. From available evidence it appears that the diagnostic use of the roentgen ray is not deleterious to either mother or fetus.

The duration of pregnancy in the cases

presented is determined by taking the last normal menstrual period as evidence that the patient was not pregnant. The date of first contact following the last normal period is used as a date prior to which the patient could not be with child. The number of days from this date, to the date of roentgen study, is considered as the number of days of the pregnancy.

It is obvious that while no case exceeds this number of days, many are considerably less if we accept the statement of Willson (18): "Counting the first day of your menstrual period as one, you are sterile beginning on the twentieth day, and remain so up to and including the seventh day after the beginning of your next menstrual period." In the cases presented, only patients who are positive of dates are used. The unreliability of Spalding's sign is demonstrated by the two cases presented, the first case of which was demonstrated six days after the cessation of fetal movements, and the second case in which 31 days were required before the sign was positive.

We believe that the technic in the production of films is of the greatest importance. Sufficient time should be taken with the patient so that she is not unduly excited. A practice exposure or two should be made by running the Potter-Bucky diaphragm so that the patient will understand and thoroughly comprehend the length of time it will be necessary to hold the breath. It is our custom to have the patient take a cleansing enema several hours prior to reporting for examination. Regular-speed screens and Potter-Bucky diaphragm are used. The positions are postero-anterior and anteroposterior, that is, face down and face up. The prone position, that is, the postero-anterior or face down, has been the most successful. The lateral view has not been of value in early cases. We have never been able to demonstrate a fetus in the lateral view that could not be demonstrated in the postero-anterior or anteroposterior views. The voltage factor is variable, from 65 to 85

kv.p., 60 ma. of current, 25-inch distance for 1 second. Compression is not used routinely. If roentgenographic cones are employed, the use of the 8-inch size is recommended for 10×12 films and the 5-inch size for 8×10 films. Several films should be exposed at each sitting, and the studies made at weekly intervals from the eighth week. It is our impression that if we cannot demonstrate a fetal skeleton by the fourteenth week, the patient is not pregnant.

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LYMPHOBLASTOMA WITH SIGNS OF RENAL INVOLVEMENT IMPROVED BY ROENTGEN THERAPY: REPORT OF THREE CASES¹

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THE three cases reported herein are presented because of the unusual complication in connection with lymphoblastoma. Each of the patients showed signs of definite renal insufficiency which decreased with roentgen therapy to the renal areas (Table I).

The explanation for the striking improvement in the renal function of our three patients is not entirely clear. The symptoms and findings may have been obstructive phenomena and, therefore, spontaneous improvement followed shrinkage of the lymphoblastomatous tissue by radiation therapy with subsequent relief of obstruction. A second possibility is that the symptoms were caused by infiltration or direct extension of the disease into the kidneys and that they improved subsequent to irradiation over the kidneys themselves. A third possibility is that retrogression of the diffuse disease process by roentgen therapy may have brought about remission of a toxemia secondary to lymphoblastoma, with partial or complete restoration of normal renal function.

REPORT OF CASES

Case I, a woman, 21 years of age, first registered at the Clinic on July 9, 1936. She had been well until three years previous to admission, at which time she had had intermittent attacks of watery diarrhea for three to four months. In October, 1933, a mass had been discovered in the left posterior cervical region and the patient was found to have a mild anemia. Early in 1934 weakness, malaise, and easy fatigability developed. The mass in the neck gradually increased in size and was excised in June, 1934, at which time a diagnosis was made of Hodgkin's disease.

About 18 months prior to her first admission to the Clinic, the patient noticed a rise in temperature to from 101° to 102° F. each evening but it always dropped to normal by the following morning. Six months previously, a widening of the mediastinal shadow had been noted in the roentgenogram of the thorax and she had been given three roentgen treatments over the chest. She had been in bed for six weeks before coming to the Clinic, because of weakness, photophobia, anorexia, nausea, and vomiting. She had lost 22 pounds (10 kg.) in weight in the six months previous.

On physical examination at the Clinic, the patient's blood pressure was 92 mm. of mercury systolic, and 60 diastolic, her temperature 99.2° F., and her pulse rate 110 beats per minute. The cervical, axillary, and inguinal lymph nodes were enlarged bilaterally. Percussion of the chest revealed no increase in mediastinal dullness. A firm tender mass was palpated in the right upper quadrant of the abdomen. Enlargement of the spleen could not be demonstrated by palpation. Urinalysis revealed nothing of significance except pus (grade 1). A diagnosis of Hodgkin's disease was made and a thorough course of roentgen treatment was given. Three courses of roentgen treatment were applied to regions of involvement between July, 1936, and January, 1937. Her general health improved and she gained considerable weight.

In March, 1937, the patient returned with the complaint that five days before admission she had noted bilateral edema of the ankles which had become progressively worse. There were no cardio-respiratory, gastro-intestinal, nor genito-urinary symptoms. Physical examination gave negative results except for the demonstration of palpable retroperitoneal lymph

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nodes and pitting edema of the legs, ankles, and abdominal wall. The urine contained albumin (grade 3), erythrocytes (grade 1), and pus (grade 1). The concentration of serum protein was 3.8 gm. per 100 c.c. and the albumin-globulin ratio was 1:2.2. The patient was hospitalized, placed on a high protein (120 gm. daily), low salt diet, given one intravenous injection of 5 per cent acacia (500 c.c.) and two roentgen treatments. On this therapy the edema improved somewhat. Following her return home, the edema of the extremities again increased. On May 8, 1937, a sudden precordial pain developed which was accentuated by respiration and was accompanied by a temperature of 102° F. A diagnosis of pericarditis was made. The following day herpes zoster developed over the right side of the chest.

The patient returned to the Clinic May 23, 1937, complaining of persistent edema of the extremities and profound exhaustion. Physical examination revealed bilateral hydrothorax, the involuting lesions of the recent herpes zoster, a palpable right kidney, and edema of the extremities. On urinalysis albumin (grade 3), casts, occasional erythrocytes, and pus (grade 1) were found. The values for the serum protein and albumin-globulin ratio had not altered appreciably since March, 1937. She received a course of roentgen treatments over both renal regions and at the time of her dismissal on June 8, 1937, the edema had disappeared and she was much improved symptomatically.

Subsequent roentgen treatment was given in July, August, and September, 1937, to regions of recurrence, but there has been no return of renal symptoms. In July, urinalysis gave negative results except for pus (grade 2).

Case II, a man, aged 62 years, first came to the Clinic Aug. 24, 1936. He had had an acute infection of the upper part of the respiratory tract in January, 1936, and one week later albumin, casts, and pus cells were found in the urine. In February, 1936, vertigo, weakness, and fre-

quent headaches over the vertex developed. Phenolsulphonphthalein test revealed excretion of 31 per cent of the dye in two hours. A diagnosis was made of acute nephritis. By April, 1936, the urine had become normal but the patient continued to feel weak. Two weeks before admission an enlarged spleen was discovered, a diagnosis of splenic anemia was made, and splenectomy was advised. He had lost 25 pounds (11.4 kg.) in weight in the two years previous.

On physical examination at the Clinic the patient's weight was 156 pounds (70.9 kg.). The heart and lungs appeared to be normal. The spleen could be palpated 5.5 cm. below the left costal margin and was slightly tender. Examination of the ocular fundi gave negative results except for anemia of the optic disks. Urinalysis revealed albumin (grade 2), casts, erythrocytes (grade 3), and pus (grade 1). The value for blood urea was 76 mg. and for serum sulphates 5.8 mg. per 100 c.c. The urea clearance was 20.5 c.c. (normal 60 c.c.) and the sulphate clearance was 16.2 c.c. (normal 20 c.c.). An excretory urogram revealed evidence of right hydronephrosis with the function of the right kidney reduced a third, and moderate pyelectasis in the left kidney with little or no diminution in function. A roentgenogram of the thorax revealed a circumscribed shadow at the level of the sixth and seventh ribs posteriorly on the left. This was suspected of being either a primary malignancy of the lung, or a metastatic lesion from a possible renal neoplasm. A lymph node from the left cervical region was excised and a diagnosis was made of lymphosarcoma. The patient received a course of roentgen treatment over the chest, abdomen, and inguinal nodes and was dismissed with instructions to follow a nephritic regimen.

The patient returned in October, 1936, stating that he had had a severe infection of the upper part of the respiratory tract with a temperature of 103° F. one week before. He also complained of frequent right occipital headaches, weakness, ex-

TABLE I.—LYMPHOBLASTOMA WITH SIGNS OF RENAL INVOLVEMENT IMPROVED BY ROENTGEN THERAPY: LABORATORY DATA

Case	Urine					Blood										
	Date	Specific gravity	Albumin, grade	Casts, grade	Red cells, grade	Pus cells, grade	Hemoglobin, gm. per 100 c.c.	Erythrocytes, million per cu. millimeter	Leukocytes, per cubic millimeter	Urea, mg. per 100 c.c.	Urea clearance	Sulphates, mg. per 100 c.c. serum	Sulphate clearance	Cholesterol, mg. per 100 c.c. plasma	Protein, gm. per 100 c.c. plasma	Albumin-globulin ratio
I	July, 1936 ¹	1.010	0	0	0	I	12.1	4.65	14,700							
	Mar., 1937 ¹	1.017	3	0	I	I	14.0	4.00	11,100	16.0				250.0	3.8	1:2.2
	May, 1937 ¹	1.020	3	+	occ	I	14.8	4.15	10,800	28.0					3.3	1:3.2
	July, 1937 ¹	1.012	0	0	0	II	11.6	4.27	9,600							
II	Aug., 1936 ¹	1.018	2	+	III	I	11.4	3.84	7,100	76.0	20.5 c.c. (vol. 150 c.c.)					
	Oct., 1936	1.013	2	0	II	IV	10.7	3.55	7,900	86.0	21.8 c.c.	5.8	16.2 c.c.	175.0	5.8	
	Jan., 1937	1.009	1	0	0	0	13.6	4.24	5,600	64.0		6.3	17.0 c.c.			
	Apr., 1937	1.005	0	0	occ	0		3.97	5,900	40.0	41.6 c.c. (vol. 200 c.c.)					
III	Jan., 1938	1.027	1	0	0	0	14.4	3.88	6,200	42.0		4.4	22.0 c.c.			
	Aug., 1937 ¹	1.023	4	+	occ	I	10.3	3.46	4,900	48.0	26.7 c.c. (vol. 96 c.c.)					
	Sept., 1937	1.025	3	0	occ	0	12.1	3.86	3,000	26.0	49.9 c.c. (vol. 110 c.c.)	12.8	5.9 c.c.	303.0	5.0	2.3:1
	Nov., 1937 ¹	1.005	0	0	0	0	10.3	3.70	5,200	26.0	62.0 c.c.	3.7	26.1 c.c.		5.5	
1 Roentgen therapy.	Jan., 1938 ¹	1.030	1	0	0	I	12.3	3.71	6,200	30.0	64.4 c.c. (vol. 35 c.c.)	4.6		245.0	6.7	3.2:1

¹ Roentgen therapy.

haustion, and some burning on urination. His weight was 156 pounds (70.9 kg.). Physical examination revealed a few fine moist râles at the base of each lung and a few small, firm, cervical lymph nodes. The spleen was barely palpable beneath the left costal margin. There was marked tenderness to palpation and percussion in the right lumbocostal region. The urine contained albumin (grade 2), erythrocytes (grade 2), and pus (grade 4). The concentration of blood urea was 86 mg. and of serum sulphates 6.3 mg. per 100 c.c. A roentgenogram of the thorax disclosed nothing abnormal. Cystoscopic examination and ureteral catheterization revealed cloudy urine from the right kidney. A diagnosis was made of right pyelonephritis. Following his return home the pyelonephritis became severe but the attack subsided in about two weeks.

When the patient returned in January, 1937, he had gained 25 pounds (11.4 kg.) in weight and was free of symptoms. Physical examination gave negative results and the spleen could not be palpated. He returned in April, 1937, for re-examination. His general health was excellent; his weight was 179 pounds (81.4 kg.) and physical examination gave entirely negative results. Urinalysis revealed nothing abnormal except for occasional erythrocytes. The concentration of blood urea was 40 mg. and of serum sulphates 4.4 mg. per 100 c.c. Urea clearance had increased to 41.6 c.c. and sulphate clearance to 22 c.c. While at the Clinic herpes zoster developed which subsided under treatment with intramuscular injections of whole blood and local applications of calamine lotion. His most recent examination in January, 1938, revealed him to be in perfect health and without complaints. His weight was 183 pounds (83.2 kg.).

Case III, a man, aged 41 years, came to the Clinic on Aug. 28, 1937. Two years previously, he first noticed slight loss of weight, and fatigability. Six months later he noticed enlarged lymph nodes in the left inguinal region, fol-

lowed by enlargement of the nodes in both cervical regions and in the right inguinal region. Two weeks before admission he had noticed marked edema of the ankles and puffiness around the eyes and face. The urine at this time was apparently normal. Urinalysis one week later revealed albumin. The patient was also found to have a moderate anemia. He had lost 20 pounds (9.1 kg.) in weight in the two years previous.

On physical examination at the Clinic the patient was found to have a definite pallor. His weight was 134 pounds (60.9 kg.). There was diffuse enlargement of all regional lymph nodes. Examination of the nasopharynx, heart, lungs, abdomen, and rectum gave negative results. There was pitting edema of the pretibial regions and ankles (grade 1). A lymph node was excised from the right cervical region and a diagnosis of lymphosarcoma was made. The urine contained albumin (grade 4), casts, occasional erythrocytes, and pus cells (grade 1). The concentration of blood urea was 48 mg. and of serum sulphates 12.8 mg. per 100 c.c. The urea clearance was 26.7 c.c. (normal 40 c.c.) and the sulphate clearance 5.9 c.c.

A course of roentgen treatments were given over the regions of definite involvement but because of the renal complication additional treatment was given over both renal regions. After treatment urinalysis revealed albumin (grade 3) and occasional erythrocytes. The concentration of blood urea had dropped to 26 mg.; that of serum sulphates to 3.7 mg., and the results of urea and sulphate clearance tests were normal. The patient was dismissed with instructions to take a high protein diet and a limited quantity of salt. During the ensuing two months the patient gained 12 pounds (5.4 kg.) in weight, regained his appetite, and noticed a marked improvement in strength.

In November, 1937, his condition was checked elsewhere. Results of tests of renal function at that time were entirely normal. Roentgen treatments were given for the recurrent adenopathy in both

cervical and inguinal regions and the left axilla. The patient returned to the Clinic in January, 1938, complaining of anorexia, nausea, diarrhea, fatigue, and loss of 6 pounds (2.7 kg.) in weight in three weeks. On physical examination his weight was 134 pounds (60.9 kg.) and pallor was evident. There were palpable, firm, shotty, cervical, supraclavicular, axillary, and epitrochlear lymph nodes. Examination of the heart revealed a loud apical systolic murmur, but the lungs appeared to be normal. Examination of the abdomen gave negative results except for tenderness (grade 1), in the midabdomen on the right. Rectal examination was negative.

Roentgenograms of the chest, kidneys, ureters, bladder, and colon showed nothing abnormal. Roentgenograms of the stomach revealed a duodenal ulcer and analysis of the gastric content showed achlorhydria. Urinalysis revealed nothing abnormal except for albumin (grade 1) and pus (grade 1). The values for blood urea and serum sulphates and results of the urea clearance test were normal.

The patient received roentgen treatment over the regions of involvement and was instructed to follow an ambulatory ulcer program and to take liver and iron for his anemia.

COMMENT

Edema, albuminuria, hematuria, pyuria, and other evidences of disturbed renal function have been reported in numerous cases of lymphoblastoma. Edema may result from involvement of blood vessels or lymph vessels by lymphoblastoma of the inguinal, iliac, or para-aortic lymph nodes, or it may be attributable to toxic involvement of the kidneys with secondary derangement of the metabolism of water and inorganic substances giving rise to a clinical picture simulating a nephrotic syndrome. Not infrequently in lymphoblastoma, especially when abdominal nodes are involved, one or both ureters may be obstructed with a resultant hydronephrosis and, in some cases, pyelonephritis.

Whether the kidneys are involved by infiltration, by direct extension, or by metastatic invasion is a debatable question. Mallory (1) stated that lymphoblastoma rarely infiltrates the kidneys. Scribner (2) reported a case in which, at necropsy, the kidneys were diffusely infiltrated with lymphoid tumors. In Knutti's (3) case of primary lymphoblastoma of the thymus gland, the only discoverable metastasis was to the kidneys. Simonds (4) stated that deposits of lymphoblastoma in the kidneys are almost always associated with involvement of the retroperitoneal nodes. Cutler (5) reported a case in which the upper portion of the left kidney was involved in a huge retroperitoneal mass which included the pancreas and was attached to the upper lumbar vertebrae.

Labbé and Balmus (6) reported a case of lymphoblastoma with retroperitoneal involvement and extension to the kidneys. Their histologic sections of the kidneys revealed nodular accumulation of lymphoblastomatous tissue, areas of diffuse infiltration, some glomerulitis, tubular compression, and fibrosis.

Among a group of patients dying from lymphoblastoma, Barron (7) found the cortices of the kidneys swollen, cloudy, and pale and it was his belief that these findings represented an acute toxic nephrosis. Boles (8) found the tubular epithelium swollen and many of the tubular cells vacuolated. Messick and Furrer (9) stated that parenchymatous degenerative changes, apparently due to toxemia, as found in lymphoblastoma, may explain the renal insufficiency not infrequently associated with the disease.

As we have stated, the nature of the fundamental derangement in renal function underlying the clinical picture in the foregoing cases, and the explanation for the striking improvement under roentgen therapy to the renal regions are not clear. However, the rate at which improvement occurred in these cases corresponds so closely to the known rate of improvement

in lymphoblastoma that the association is almost inescapable.

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PALLIATIVE RESULTS IN RADIATION THERAPY OF ADVANCED CARCINOMA OF THE CERVIX¹

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KINGS County Hospital is a general hospital with approximately 3,000 in-patients and a large out-patient department. It is one of the associated hospitals of the Department of Hospitals, City of New York. The radiation therapy service in Kings County Hospital is a unit of the cancer service of the department of hospitals. The in-patient cases included in this survey come largely from the service of Dr. Cameron Duncan.

The material to be reviewed includes all the advanced cases of carcinoma of the cervix referred to the radiation therapy department for treatment from 1931 to the beginning of 1936. In other words, in the most recent cases reported, over a year has elapsed since the end of treatment. The first cases treated have passed six years. While the time interval is much too short to permit a discussion of cures, yet it is ample to justify a review of the palliative value of radiation therapy in advanced cervical carcinoma. The character of material seen at Kings County Hospital is discouraging at the outset. Our clientele consists largely of the poorer charity patients—patients who neglect themselves too long, patients who lack the intelligence or ease needed for better co-operation. The hospital also serves as the recipient of free patients treated inadequately or unsuccessfully at other institutions throughout the city.

In classifying our material, we have followed the scheme of Schmitz, with one slight modification. We felt that we were justified in including in Group III those cases in which the cervix was extensively involved without definite palpable parametrial infiltration, but in which the cervical canal is atresied by neoplasm. The atresia of the cervical canal prevents adequate application of radium. The prognosis in these cases is similar to that in Group III. Essentially, the clinical classification of carcinoma of the cervix can be reduced to two main groups: Schmitz Groups I and II in which the cervix alone is involved, and Schmitz Groups III and IV in which the pathology has spread beyond the cervix. One hundred forty-one cases of cervical carcinoma in Groups III and IV are included in this review. These cases represent 92 per cent of all the carcinoma of the cervix referred to the department. Thirty-two of our patients received treatment at other institutions prior to their admission here. Frequently the treatment received had been considerably less than that which we felt advisable. Forty-one patients were classified as in clinical Stage III, 100 patients were classified as in clinical Stage IV.

Microscopic examination classifies 83 per cent of the cases as epidermoid carcinoma, and 17 per cent as adenocarcinoma. Grading of the degree of malignancy was carried out in relatively few cases. Our pathologists feel that the grading of malignancy is still of doubtfully proven value. Our own clinical experience is in accord with this, for not infrequently have we found lesions that were reported as highly sensitive to radiation which did not respond to massive dosage of radiation. Furthermore, some tumors considered radiation-resistant disappeared grossly even before the course of preliminary x-radiation was complete. In a few instances successive biopsies of the same tumor were reported at one time as radiation-resistant

¹ Presented before the Fifth International Congress of Radiology, Chicago, Sept. 13-17, 1937.

and at another time as radiation-sensitive. Our own experience leaves us unimpressed as to the importance of the grading of malignancy as a factor in determining dosages to be given. All patients were treated with the maximum dosage considered safe to be administered.

Symptoms.—Bleeding was the predominant symptom and the chief complaint in 123 cases. The duration of bleeding even in the advanced cases varied between a few weeks and almost two years. When the bleeding was of short duration, there was always a history of a previous foul, watery discharge, and examination showed instead of an exophytic friable mass, a sloughing, indurated, secondarily infected, neoplastic crater.

Twenty-one patients arrived in good condition, 71 in poor condition, and 39 were definitely cachectic. Those not in good condition complained of weakness, shortness of breath, and the other major symptoms of secondary anemia.

Forty-two patients complained of pain in the pelvis and lower back. Thirty-eight patients complained of a watery discharge. Fourteen complained of frequency of urination or dysuria. Two patients complained of inguinal lymph-gland swellings. Five patients had either rectal or vesical fistula.

Treatment.—The maximum dosage as yet delivered to extensive pelvic carcinoma is too frequently below that needed for complete carcinoma cell death. With the popularization of the protracted, fractionated method of administering x-ray therapy as advocated by Coutard and others, radiation therapists throughout the world have rapidly altered their conception of tissue tolerance and available dosage. If we are to increase our therapeutic results, we must bring the total parametrial dose near to what we believe to be the carcinoma lethal dose. Perhaps further application of the principles involved in the time-spacing of treatments, will permit increased total dosage and increased carcinolytic effect. Our treatment technic has been as follows: 200 kv. Thoraeus filter of 2 mm. Cu equiva-

lent, 50 cm. F.S.D., 100 r in air measured to each of four pelvic fields daily until 3,000 r has been given to each field. Fields measured approximately 10×15 cm. and the rays were directed so as to converge into the pelvic floor. In no instance was cystitis or proctitis produced although the bladder and rectum were not protected.

Immediately on completion of x-ray treatment, each patient was re-admitted to the hospital for radium insertion. A Gaillard sound containing three 15-mgm. capsules of radium element was placed within the canal and three corks of a colpostat, each containing 10 mgm. of radium were placed within the vagina, one cork resting in each lateral fornix and one cork anterior to the cervix. The rectum and bladder were packed away with a few folds of gauze vaginal packing. The rest of the vagina was filled with plain gauze packing to prevent undue change in position of the radium applicators. Thus, 75 mgm. of radium were used and permitted to remain in place for 96 hours, yielding a total dosage of 7,200 mgm.-hours. In those cases in which the cervical canal was atresed, no effort was made to dilate the canal and only the intravaginal applicators were used. If the carcinoma was bulky, exophytic, it usually shrank to practically normal within from four to six weeks. By then the canal usually was found to have become patent again. The intra-uterine radium application was given as soon as patency was established. In one instance a bulky cauliflower-like tumor was removed using a coagulation loop. Electrocoagulation is not advised—it is associated with danger—the coagulation may extend well into the vaginal vault and lead to subsequent hemorrhage or pyometritis. Furthermore, it is superfluous inasmuch as the exophytic carcinomas that might be snared off respond very readily to radiation. The radium dosage was usually given as one treatment without repacking the vagina, hence making a reinsertion of the radium unnecessary. If the patient's temperature rose above 101° F.

on the second or third day, the radium was removed, the vagina douched, and the radium reinserted a few days later. In only a small percentage of the cases was there sufficient morbidity to warrant interruption of the four-day continuous application. It is wise to plan the total radiation as one continuous course and not to attempt second, additional cycles or series of treatments. The first cycle or series of treatment is the most effective and should be as intensive as possible. Subsequent therapy is associated with additional danger and produces very little, if any, therapeutic benefit. In one instance a secondary cycle of radiation given almost two years after the first series, led to a late radiation necrosis of the lower pole of the cecum, with perforation and fatal peritonitis. The radium dosage of 7,200 mgm.-hours, correctly applied, never produced any severe local symptoms, proctitis, or cystitis. When the dose was carried to 8,000 or more mgm.-hours, a three- or four-week proctitis was a usual complication. In no instance was a rectal or bladder radium fistula encountered. One case, on autopsy, several weeks after radium insertion, showed a perforation of fundus uteri with a conical zone of necrosis. This case had been curetted seven days before. The zone of necrosis was not far from the tip of the radium applicator; in other words, in the region of the uterus receiving the smallest total radium dosage. The perforation, therefore, represented a surgical rather than a radiation complication. In five cases a laparotomy was performed and an attempt was made at carrying out a pelvic lymphadenectomy similar to that recommended by Taussig. Radon seeds were inserted into the residual gross neoplastic tissue. The post-operative courses in these cases was always hectic; repeated transfusions were required, and in one patient a rectal fistula was produced. Two of these five patients subsequently died with extensive pelvic infiltration, urethral obstruction, and progressive cachexia. In one case, re-opened a year after the seed implantation, no gross pathology could be

found. This is the only really successful seed implantation case in our group. The procedure here was limited to seed implantation—no lymph gland resection was done. The series of five cases is too small to warrant definite conclusions, but the suggestion is made that lymphadenectomy or seed implantation is applicable only in the earlier cases, that is, in those cases in which the therapeutic results are favorable even without this procedure.

Relief of Symptoms—Bleeding was controlled in 66 per cent of the cases treated. Many of the patients who were bed-ridden and exsanguinated on admission, improved so markedly after treatment that they returned to their homes able to do their housework and to care for their families. Frequently, this improvement was temporary but nonetheless definite and welcome. The general condition of the patient was definitely improved in 43 per cent of the cases treated. The hardest cases to help were those in whom the lesion at the time of first examination was sloughing, foul smelling, ulcerated, flush with the vaginal vault. The bulkier lesions, those without extensive secondary infection or necrosis, responded very satisfactorily. The local lesions healed completely in 36 per cent of the cases treated. The palpable pelvic infiltration healed in 14 per cent of the cases treated; however, the lumbar pain did not always disappear with the disappearance of the palpable mass. Pain was relieved in only 5 per cent of the cases treated. The watery discharge was relieved in only 3 per cent of the cases treated. Twenty-seven of the 141 cases seen are still alive and 12 of these are, grossly, cancer-free. Of all the Group III and IV cases seen, 11 per cent are known to have lived from one to six years or more after completion of their treatment. However, correcting these figures by eliminating those cases that arrived in such poor condition that they did not live through the weeks necessary to complete radiation therapy, or who were too cachectic to be treated, there is a survival rate of 32 per cent. Of all the cases seen, 76 lived less than six months, 20

survived from six to 12 months, 18 survived from 12 to 18 months, nine survived from 18 to 24 months, 10 survived from 24 to 36 months, four survived from 36 to 42 months, two survived from 48 to 54 months, and two survived more than five years.

The immediate cause of death was difficult to establish. The claims for urethral obstruction as a major cause of death could not be substantiated in our own group of cases. In only five of the cases studied could definite urethral block be demonstrated. Secondary hemorrhage and the sequelæ of long-standing pelvic infection with its progressive cachexia dominate the clinical picture.

CONCLUSION

Radiation therapy adequately administered offers definite palliation in a large percentage, and a cure in a small but constant percentage, of those suffering from advanced carcinoma of the cervix. This treatment should be resorted to in all but the extremely cachectic cases. Further improvement in therapeutic results from radiation probably depends on our ability to increase still more the total radiation dose and to understand better the problem of time and space distribution of the dosage.

THE BIOPHYSICAL BASIS OF ULTRA-SHORT WAVE THERAPY¹

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1. INTRODUCTION

AT the present time three problems are of especial importance in regard to the medical applications of ultra-short waves: (1) dosage measurement; (2) the relation of selective heating effect to wave length; (3) the specific effects of ultra-short waves (athermic, or specific electric effect). This last problem lies mainly in the field of medical biological investigation, while the first two are entirely within the field of biophysical research, and are accordingly the subject of our present considerations.

Modern ultra-short wave apparatus is serviceable and reliable and enables us to make more or less exactly reproducible applications of ultra-high frequency energy. There is, however, no reliable dosage procedure which permits, in any given case, the correct determination of the energy transferred. Especially is it difficult to measure the dosage during the actual treatment. The present practice in ultra-short wave therapy is to rely on the subjective reaction of the patient. The resulting dose can, in general, only be determined in an empirical manner.

As a result of the difficulties of exact dosage determination, it has not as yet been possible to make any definite observations or to reach any conclusion regarding so-called "specific effect" of ultra-short waves, and in the present state of affairs it will continue to be impossible to do so.

The idea of constructing the treatment system, on the basis of physical and physiological-anatomical considerations, in such a manner that conditions can be so predetermined that a favorable transfer of energy may be expected, leads directly to the second of the above-mentioned problems;

the wave length dependence of the effects of ultra-short waves. That is, is it possible, by an appropriate selection of the wave length region, to influence the transformations of the high frequency energy in various body tissues in the desired direction? Within recent years considerable research has been done on this problem, which is of the greatest importance, both for the practical application of ultra-short waves and for any investigation into the mechanism of their biological effects. As a result of this research, there is to-day available some definite knowledge regarding the distribution of the high frequency energy, and also the mechanism of its conversion in the irradiated body. On this basis the problem is divided into two parts: on the one hand the investigation of the "external" or geometrical conditions for the supply of the high frequency energy, and on the other, the determination of the actual distribution of the high frequency energy within the body. The first part of the problem is directly concerned with such matters as size, shape, material, and arrangement of the electrodes. The second has for its purpose the determination of the electrical characteristics of biological bodies; that is, their high frequency conductivity and dielectric constant (DK), as well as the clarification of the bearing which the stratified, fibrous, or cellular structure of the individual tissues has on these constants. While the questions regarding the "external" conditions are relatively well cleared up, and have found sufficient place in the literature, those regarding the inner mechanism of the passage of the ultra-short wave current have up to now been little considered.

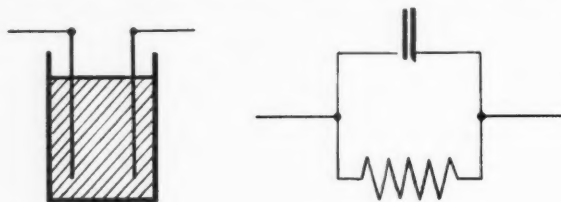
2. THE PRINCIPLE OF SELECTIVE HEATING

Animal tissue is, from an electro-physiological point of view, a complex, poorly con-

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ducting body, whose outstanding characteristic is its macroscopic stratified structure, and its microscopic and submicro-

If a high frequency voltage is impressed across its terminals, the resulting current consists of two parts: a conduction cur-



$$I_R = \frac{E}{R} ; \text{ wave length } \underline{\text{in}} \text{ dependent}$$

$$I_C = \frac{E}{\frac{\lambda}{\gamma C}} ; \text{ wave length } \underline{\text{dependent}}$$

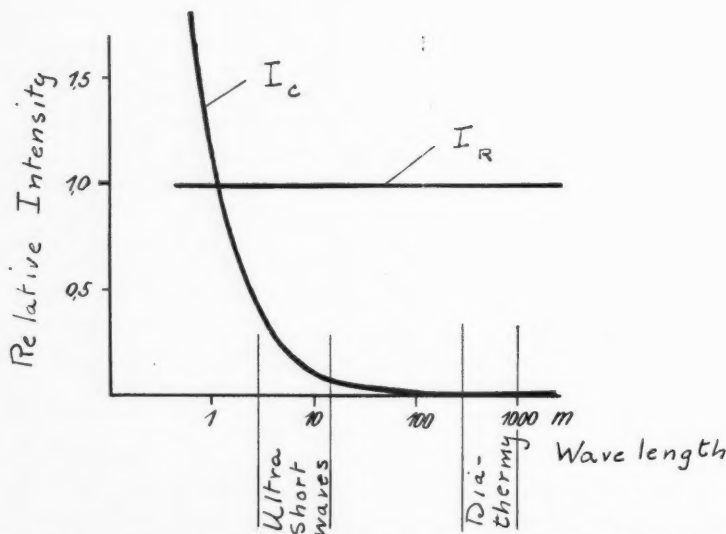


Fig. 1. Simple equivalent electric circuit for the conductivity of a biological body in a high frequency condenser field.

scopic fiber-, cell- or colloid-structure. The different components of tissue possess, in general, different values of conductivity and dielectric constant. The body can, therefore, be considered as an inhomogeneous dielectric. The passage of a high frequency current through such a body can be symbolized by the type of electric circuit shown in Figure 1. It consists of a resistance R and a condenser C in parallel.

rent I_R through the resistance R , which produces heat, and a so-called capacity displacement current I_C , which flows without energy loss. $I_R = \frac{E}{R}$, where E is the

alternating voltage across the condenser, and $I_C = \frac{E}{\frac{\lambda}{\gamma C}}$ where λ is the wave length,

γ a constant, and C the capacity. It is important to note that the first, the conduction current, is independent of the wave length, while the second increases with decreasing wave length (See Fig. 1). The wave length region for ultra-short wave therapy is such that the conduction and displacement currents in the irradiated tissue are of the same order of magnitude.

The displacement current makes it possible to irradiate non-conductors without waste of energy. In ultra-short wave therapy, the metallic contact between the electrodes and the skin can be omitted and the electrodes set at a distance from the body. Such an arrangement is called a condenser field. First described by Esau, it has proved to be the most suitable method for ultra-short wave irradiation of biological objects.

It is of especial interest to investigate the laws governing the distribution of energy within an irradiated cross-section of tissue. Such a cross-section, in practice, consists of a series of several tissue layers, with different conductivities and different dielectric constants, and the question is how the energy distribution in these various layers varies with the wave length.

Schliephake (1) found, in the first investigation of this question, that for a series of salt solutions of various concentrations, there was a wave length dependence of the heating of the individual solutions. Paetzold (2) showed, in support of this, that this is an entirely normal consequence of the theory of alternating currents, since the relative intensities of the conduction and displacement currents are different, in the different layers, for different wave lengths, and therefore the resultant development of heat should have a wave length dependence. According to this, there should be, for every tissue having a certain conductivity and dielectric constant, a certain wave length which should give the maximum effect; this wave length can be determined by the formula given by Paetzold. Other workers have verified this, both in theory and practice (3, 4).

The thorough investigation of this "prin-

ciple of selective heating" requires involved mathematical considerations. We will here consider briefly only the basic results: first, the formulation of the principle itself. Its therapeutic application consists in the delivery to a certain layer of tissue, or to a certain organ, the largest possible amount of energy, with the greatest possible avoidance of neighboring layers or structures. Quantitatively the state of affairs is best expressed by the quotient $Q = \frac{H \text{ desired}}{\Sigma H \text{ undesired}}$,

where "H desired" is the energy delivered to the tissue under consideration, and " ΣH undesired" is the sum of the energies delivered to all the other tissues. The selective warming of a tissue requires, obviously, that the quotient Q , which we may call the selectivity factor, shall be a maximum; the problem, therefore, is to find the wave length which produces this situation. In statements of the principle of selective heating heretofore published, it is indicated that for every tissue of a definitely determined conductivity and dielectric constant, there is an optimal treatment wave length which will make this factor a maximum. As will be shown below, the value of the quotient Q depends on the relation between the magnitudes of the conductivity and dielectric constant of the various tissue layers. For this reason, Paetzold's formula is subject to certain limitations. First, it is obviously not applicable to the treatment of a single layer. In this case, the heating effect increases regularly with increase in wave length, for a constant current. Also in the case of two layers there is no optimal wave length. For three or more layers, however, the matter deserves consideration. In Figure 2, A, B, and C are given diagrams to aid in the consideration of this case; here we have various arrangements of three layers having the same dielectric constant but different conductivities. In the general problem, the layers would also have different dielectric constants, but in the interests of simplicity we will consider only the special case. This is not unreasonable, since actually, for various body tissues, the dielec-

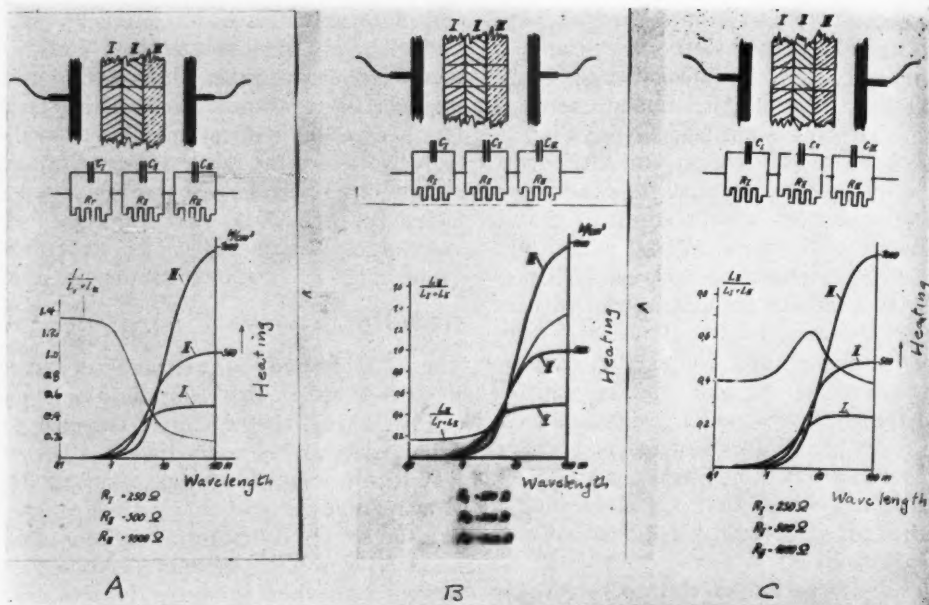


Fig. 2. High frequency heating of one layer of tissue out of three having different conductivities and the same dielectric constant.

- A. The layer to be heated has the greatest conductivity L_I .
- B. The layer to be heated has the least conductivity L_{III} .
- C. The layer to be heated has a conductivity between the other two L_{II} .

tric constants in the ultra-short wave region are about the same, with few exceptions. As my collaborator, H. Schaefer, has stated, with such stratifications, three cases must be considered:

1. The conductivity of the layer to which it is desired to deliver the maximal dose is greatest of the three; or
2. it is the least; or
3. it is intermediate between the other two.

Of these three possibilities, the first leads to the conclusion that the shortest possible wave length produces the desired result. In this case, then, there is no meaning to the expression of an optimal wave length. Correspondingly the second case leads to the need for the longest possible wave length. Only in the third case is there an optimal effect for a determinable wave length, for which Paetzold's

formula holds, namely, $\lambda = \frac{\epsilon \rho}{6 \times 10^3}$ where

ρ is the specific resistance of the tissue, ϵ its dielectric constant, and λ the wave length. These considerations are best shown by a graphic representation of Schaefer (3) reproduced in Figure 3-A. Here are given curves showing the relation between the heat produced by various wave lengths and the conductivity of the irradiated tissue, when the apparatus is operated so that for every wave length the same heat is developed for one particular conductivity (Point I). For this example, this conductivity is selected as that which will develop a maximum dose for radiation of 6-meter wave length. Case 1 above is now illustrated by a consideration of layers I, II, and III. Here, for the 6-m. wave length, the undesired total in II and III relative to I is about 150 per cent (selectivity factor 0.67).² On the other hand, the corresponding undesired dose for a 3-m.

² $H_{\text{desired}} = 250$. $\Sigma H_{\text{undesired}} = 215 + 160 = 375$
 $Q = \frac{250}{375} = 150$.

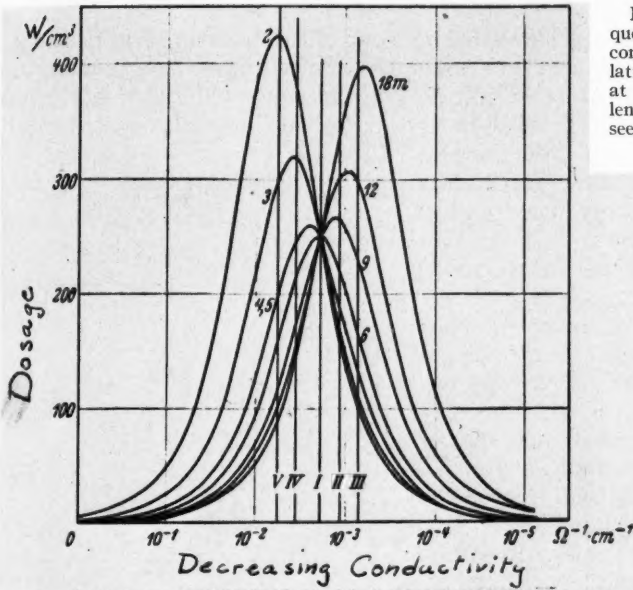
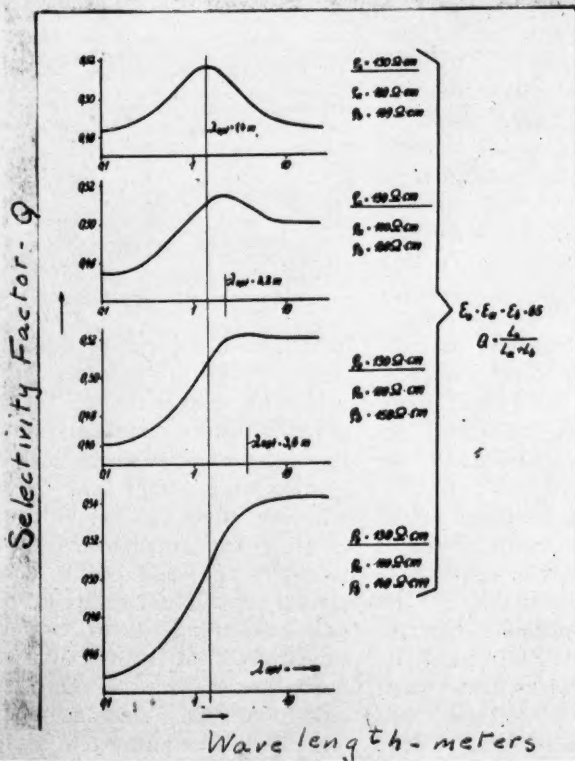


Fig. 3. A. High frequency heating in a condenser field, in relation to conductivity at different wave lengths. (For details, see text.)



B. Shift of maximum in selectivity factor because of constants of adjacent tissue layers.

wave length is only 109 per cent (selectivity factor 0.92). Case 2 is illustrated by layers V, IV, and I. Here again the undesired total for 6-m. radiation is 150 per cent of the dose at I, while in this case the longer wave length of 12 m. gives a smaller total of 109 per cent. Case 3, for layers IV, I, and II, is the only one to which Paetzold's formula applies. It is apparent, then, that the application of the principle of selective heating is possible only in certain special cases. This must be emphasized because, even in the third case just mentioned, considerable deviations may occur between the actual optimum wave length and that calculated from the formula, because of the constants of the neighboring layers of tissue. These considerations are best illustrated by Figure 3-B, in which is shown the displacement of the optimal wave length produced by changing the conductivity of one of the outside layers, keeping that of the other two layers constant.

The quantitative determination of the above relations is possible only if the numerical values for the conductivity and dielectric constant of the biological tissues in the short wave length region are known. Hence speculations as to the possibility of relative heating of various body tissues are of no value, as we pointed out more than five years ago. In order to clarify this matter, and also for other fundamental reasons, we have undertaken a systematic measurement of the conductivity and dielectric constant of all therapeutically important tissues in the ultra-short wave region, from wave lengths of 0.5 to 1,500 meters. These measurements, which we have already published (5, 6, 7, 8, 9, 10, 11), have led to a series of results which are of basic importance, not only with regard to the matters considered above, but also to general considerations concerning the mechanism of the distribution of high frequency energy in irradiated biological tissues. Meantime results along these same lines have been published by Fricke and Curtis (12), Esau, Paetzold, and Ahrens (13), Bachem (14), and Osswald (15),

which are in good agreement with our own and with the theoretical developments we have made from these results. In Table I are given the individual values for conductivity and dielectric constant for various

TABLE I.—CONDUCTIVITY AND DIELECTRIC CONSTANT OF HUMAN TISSUES FOR THREE-METER WAVE LENGTH (37°)

Tissue	Conductivity × 10 ³	Dielectric Constant
Muscle	8.5-10.4	65-75
Kidney	8.5-10.0	
Brain	4.5- 6.25	
Spleen	9.6-11.6	
Lung	7.7-11.5	
Heart muscle	7.8- 9.2	
Liver	6.3- 8.7	
Gastric mucous membrane	10.0	
Subcutaneous fat	0.83	9-13
Skin	2.1- 6.25	

TABLE II.—CONDUCTIVITY AND DIELECTRIC CONSTANT OF ANIMAL TISSUES FOR THREE-METER WAVE LENGTH (37°)

Tissue	Conductivity × 10 ³	Dielectric Constant
Muscle	6.8 - 8.5	71 - 76
Liver	5.6 - 6.5	76 - 79
Spleen	8.3 - 8.4	100 -101
Kidney	6.9 -11	87 - 92
Brain	5.1 - 5.6	81 - 83
Pancreas	4.1 - 5.9	60 - 75
Fat	0.4 - 0.58	11 - 13
Bone marrow	0.20- 0.35	6.8 - 7.7
Blood	10 -12.5	73 - 76
Serum	16	76

human tissues, for a wave length of 3 meters; Table II presents corresponding values for animal tissues. If these values are used for the determination of the relative quantitative effects in selective deep heating, it is found that, in general, the selective effect, as related to the wave length, is very small, even for very different values of the conductivity of the various layers. An actual example for body tissues is given in Figure 4-A (*after* Schaefer), showing the attempt to produce specific heating in the liver, as related to skin and gastric mucous membrane. Obviously there is no advantage, in such a case, in attempting to treat with an "optimum"

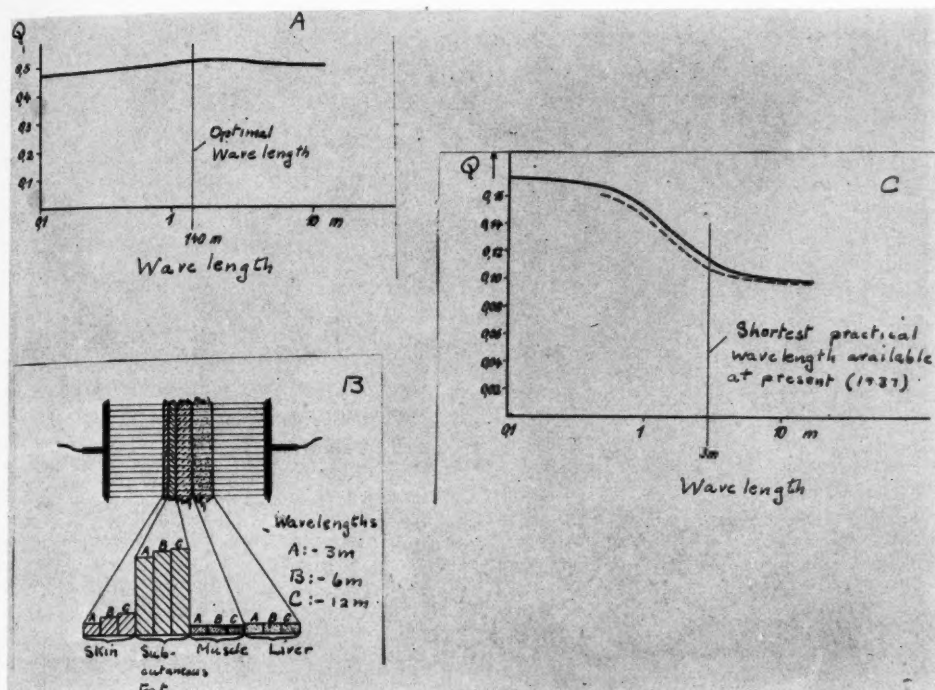


Fig. 4. Wave length effects in animal tissues.

- A. Skin-liver-gastric mucous membrane. Q = relation of desired dose (in liver) to undesired (in other tissues).
 B and C. Variations in dose in combination skin-subcutaneous fat-liver with variations in wave length. Extreme electrode spacing, giving homogeneous field. Dose in liver maintained constant.

wave length rather than with any other. Only in one particular case is this really possible, namely, in the heating of subcutaneous fat. This tissue has a conductivity and dielectric constant completely outside the range of those for other tissues. And here there is actually a definite example of the often mentioned wave length variation in the relation between the useful and the undesired heat. The quantitative relations are shown in Figure 4-B and C. They lead, actually, to the indication of the shortest possible wave length as the desired one. It should be noted that any selective heating effect for fat is found only for wave lengths below 3 m. The values for the temperature effects in fat as calculated from the measured values for conductivity and dielectric constant, which are given in the figure, are in good agreement with the direct temperature meas-

urements of Esau, Paetzold, and Ahrens (13), and of Bachem (14).

3. THE MICRODISTRIBUTION OF THE HIGH FREQUENCY ENERGY IN THE TISSUES

Even though it can be shown that, except for special cases, the hope for a selective distribution of high frequency energy among various organs cannot be realized, still the stratified structure of biological tissues is important, for another reason. The microscopic layer structure of the cell groups and of the single cells exerts a strong influence on the distribution of the energy in the irradiated tissue.

Researches which have been carried on in our laboratory for many years, on the behavior of biological objects in the high frequency condenser field, have led us to the announcement and the theoretical establishment (Daenzer, 7b) of a series of

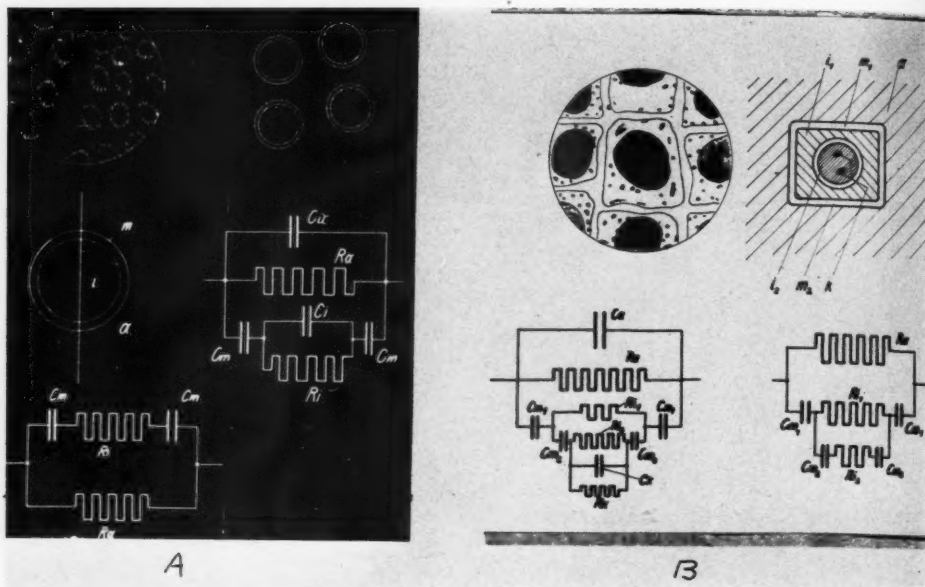


Fig. 5. Diagrams of structures and equivalent electric circuits.

A. Blood.
B. Cellular tissues

concepts whose further pursuit has proved very fruitful (16, 17). For the essential confirmation of this theory, it is necessary to know the wave length dependence of the conductivity and dielectric constant of the individual tissues. This problem may be readily illustrated by concrete examples—as a relatively simple one, the blood, and as a complicated one, the cellular tissues. In the first case we have to deal with a suspension; the blood corpuscles can be considered as hollow spheres suspended in a conducting fluid. Each corpuscle is composed of a semi-insulating shell (membrane) and a conducting fluid within this shell. It makes no difference in the following considerations, whether the corpuscle is considered as a sphere covered with a membrane, or as a particle having a honeycomb-like inner structure. Correspondingly, we can consider a cell group as a complicated manifold layer, which consists of poorly conducting membranes and framework, and, enclosed in these frames, the better conducting cell fluids. If one analyzes the behavior of such a system in a high frequency

field, he comes to the situation which is illustrated in Figures 5-A and 5-B. The actual biological tissues and cells can be replaced diagrammatically by the equivalent electrical circuits shown. It is important, in these circuits, that all condensers should be independent of wave length. Then according to the wave length used, the system will show varying total conductivity, since the current flowing in the individual conducting parts of the cell will vary according to the wave length. These theoretical considerations have been fully established experimentally; the conductivities and dielectric constants of tissues are found to be strongly wave length dependent. Examples of this are shown in Figure 6-A, where the specific resistance, or the reciprocal of the conductivity, is the ordinate of the curve. It is evident from these curves that the variations with wave length are not of the order of a few per cent, but are much greater. For example, measurements on blood have shown that in the ultra-short wave region, as opposed to longer waves (diathermy), for the individ-

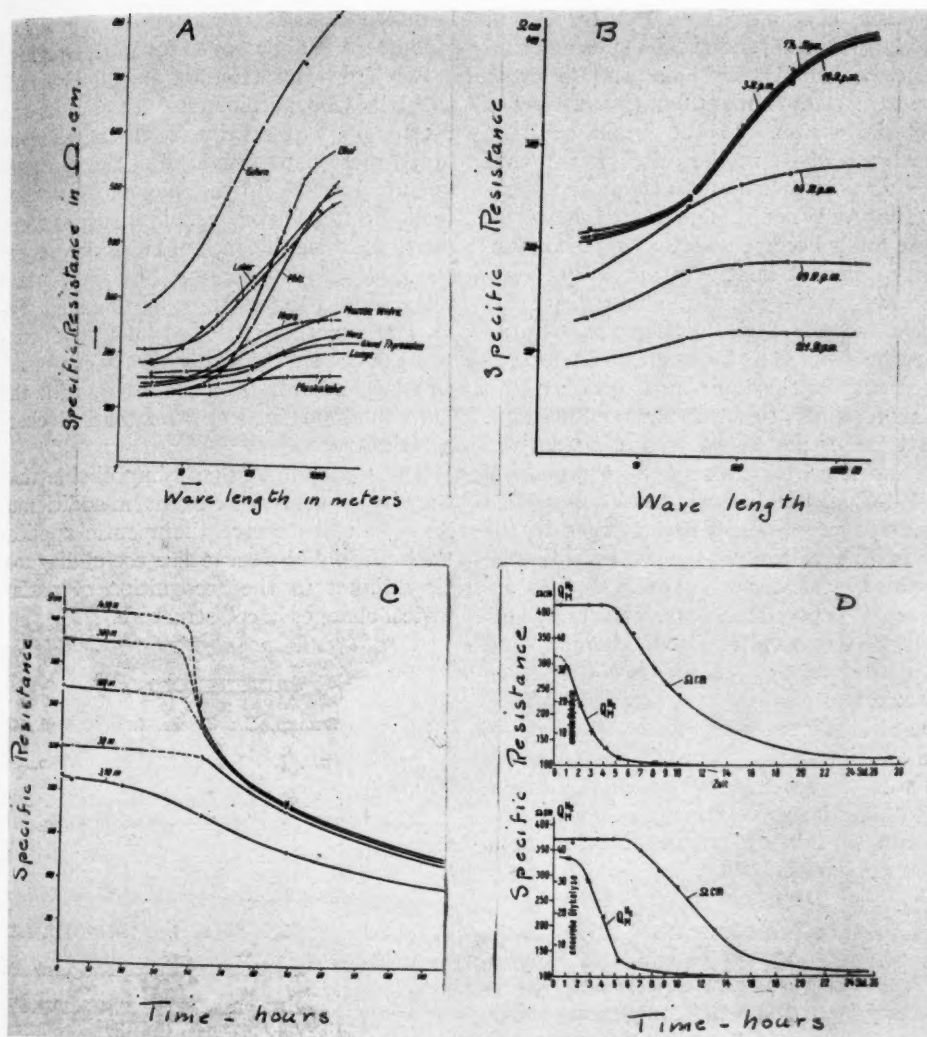


Fig. 6. A. Dispersion curves for high frequency conductivity in various tissues.
 B and C. Variation with hours after death in the high frequency conductivity curves for rabbit liver.
 D. Variation with time in glycolysis and in growth ability in sarcoma tissue subjected to autolysis.

ual blood corpuscles there is a 20-fold increase in energy absorption. Thus there is a complete change in the whole picture of energy transfer.

In addition to the consequences which these facts have on the practical application of ultra-short wave therapy, there is further important information to be gained from measurements of conductivity and dielectric constant. If the cell structure

has any influence on the wave length dependence of the conductivity (the so-called dispersion curve), then changes in the cell structure must express themselves in changes in the shape of this curve. The experiments verify this completely. First let us consider individual differences in dispersion curves for tissues of the same sort, such as are shown in Figure 6-B, for liver. Even more definite are the changes in high

frequency conductivity with destruction of the cell structure, such as take place, for instance, in hemolysis of blood corpuscles, or in postmortem changes due to autolysis or bacterial action. In the intact cell, the membrane shuts in the cell fluids so that they do not participate in the general conductivity. When it is destroyed, however, these fluids become a factor in the conductivity, even at relatively low frequencies, *i.e.*, long wave lengths. The dispersion curve for the high frequency resistance must be lowered as the result of such processes, and in the limit must go over to a straight line (electrolytic conduction). That this is actually the case is shown in the experimental examples of Figures 6-B and 6-C. In addition to these cellular destructive processes, other changes in the life history of the cell can be investigated by this type of dispersion analysis. For instance, it is possible to correlate the life activity of tissue cultures with the measured dispersion curves. In Figure 6-D is given an example of this, for a sarcoma tissue. The abscissæ show the time elapsed since the excision of the tissue fragment, the ordinates, the specific high frequency resistance and the glycolysis (Q_M^N), or the frequency of takes of tissue cultures made from the same tissues.

CONCLUSIONS

From the results of experiments herein described, the following conclusions can be drawn:

1. Under the conditions of present-day ultra-short wave therapy, there is in general no possibility of a practical application of the so-called principle of selective heating. Recent investigations along these lines indicate, in the main, the advisability of using the shortest possible wave length. Especially favorable relations appear to exist in the region of about three meters, which is, however, practically not very ac-

cessible at present. Further technical development is to be hoped for in this region.

2. The characteristic peculiarities of the behavior of biological tissues in the ultra-short wave region lie in the elementary (microscopic) division of the high frequency energy in the biological system (cell groups, blood, colloidal suspensions, etc.). The significance of this microscopic tissue structure is expressed by the marked wave length dependence of the high frequency conductivity and dielectric constant of the tissue, which always conforms, as experimentally demonstrated, with the individual physical and anatomical characteristics.

3. It does not appear improbable that the ultra-short wave current, in addition to its already extensive therapeutic applications, should also serve as a useful diagnostic adjunct in the recognition of pathological changes in cell structure.

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NEWER STUDIES ON THE CLINICAL APPLICATION OF VERY SHORT ELECTRICAL WAVES¹

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TREATMENT with short wave diathermy in a condensor field, using frequencies from 2×10^7 to 10^8 Hz (or wave lengths from 15 to 3 meters) is definitely superior to long wave diathermy (3×10^5 to 10^6 Hz or 1,000 to 300 meters wave length) as regards deep doses and the

short wave energy which can be applied is limited because of the increase in the temperature of the subcutaneous fatty tissue. I call attention to the difficulties encountered when trying to produce high temperatures within the pelvis when treating local gynecological conditions. Some of the

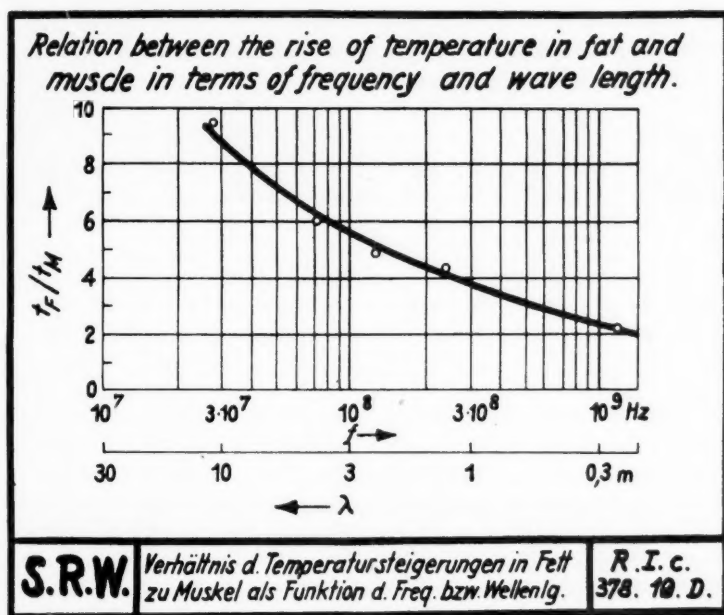


Fig. 1.

possibility of controlling the energy. From a physical point of view this superiority is due to greater thermal penetration of poorly conducting macroscopic and microscopic layers of tissue because of an increase in the capacitative conductivity and of the ohmic conductivity of the tissues. But even at wave lengths of 6 meters, there is such a strong thermal stress on the fatty tissues that the dose of

principal difficulties encountered in deep therapy are: (1) The circulation of blood in muscles and deep organs is greater than in the subcutaneous fatty tissues, and the blood stream disperses the heat more rapidly from these organs; (2) skin and subcutaneous fatty tissues are closest to the electrode and, therefore, lie in stronger fields than do the deeper lying tissues of the body, and (3) the caloric water value for fat is lower than for muscle and deeper seated organs because of its lower specific

¹ Presented before the Fifth International Congress of Radiology, at Chicago, Sept. 13-17, 1937.

weight and specific heat; in addition, the heat conductivity of fat is less than that of muscle.

large blood vessels. If, however, deeply seated organs of the body are to be heated, the conditions do not favor eddy currents,

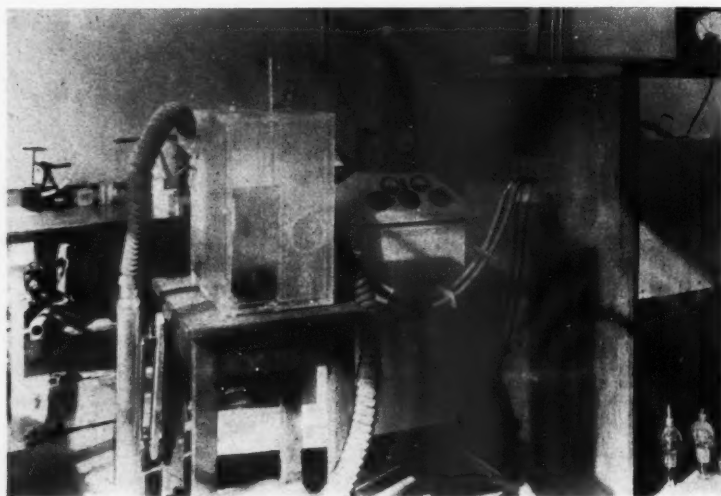


Fig. 2.

These considerations raise the following important question: How can the severe thermal stress upon the fatty tissues be reduced, or, in other words, how can the deep dose be increased for local treatments? Obviously, the three factors mentioned above cannot be altered.

Another method of applying short-wave energy to a part of the body would be to place it in the electrical field of a coil; however, this method again does not give greater deep effects within the tissues. Numerous studies on layers of electrolytes within the range of body conductivities (10^{-4} to $10^{-2} \Omega^{-1} \text{ cm}^{-1}$), as well as on biological material, have shown that the temperatures produced by these eddy currents in certain layers having high internal conductivities and low surface conductivities are better than those secured by the condensor field method insofar as the thermal stress upon the fatty tissues is concerned. However, the conditions which hold for this arrangement of tissue layers in the human body are present only in the extremities and in the trunk and then only if the treatment is limited to the heating of the connective tissues which contain

since these organs in themselves have only conductivities of the same order as muscle tissue through which blood flows. According to the studies on conductivity of high frequency waves made by Schaefer and Oswald, most tissues have even less conductivity than muscle. A careful study for the range of conductivity of the human body shows that the greatest conductivities occur at least twice within the layer, and for the eddy currents, this results in an absorption of practically all the energies by the outer layers which have the highest conductivity.

Shorter waves for eddy currents are not important because the distribution of heat within the layers does not change with wave length for eddy currents. On the contrary, the increase of the feeding frequency of short waves compared with the frequencies used formerly is injurious and causes the autofrequency of the coil to be small compared with the feeding frequency; therefore, the effects of this coil are no longer purely inductive. If feeding frequencies are employed which are large compared to the frequency of the coil used for treatment by the coil field method, the

coil reacts like a capacity and the laws of heating of materials in a condensor field also hold for the heating of tissue within

Institute of the University of Jena. For the first time we had at our disposal wave lengths down to 25 cm., using 30 watts.

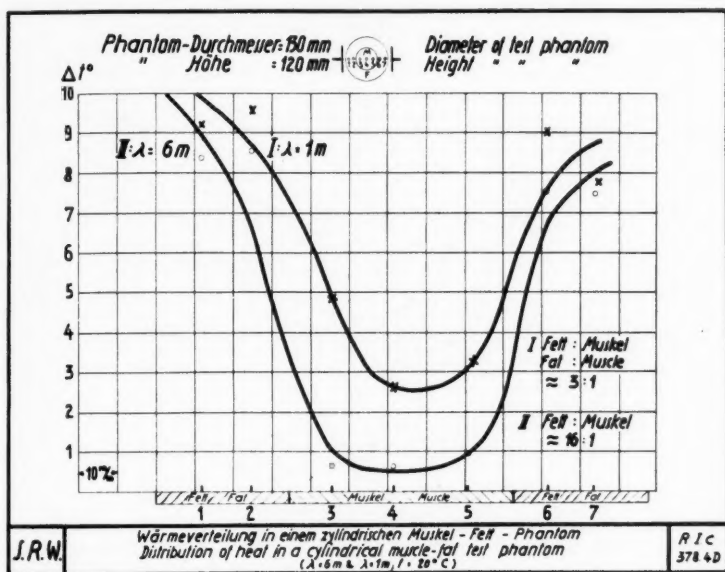


Fig. 3.

this coil. These relationships in regard to the heating of tissues with eddy currents can be mentioned only briefly, but it may be concluded that the principle of the coil never can produce higher depth doses in the body effectively.

In seeking methods to increase the depth dose, it seems advisable to carefully study the relative heating within the condensor field. It is well known that under certain conditions the relative heating of different layers can be changed on the basis of the theory of heating of layer dielectrics. If this is true then it is necessary to investigate the relationship of frequency to the heating of fat and muscle tissues because the frequency is the only factor which can be changed at will.

The measurements made on fat-muscle layers which have been published do not explain this problem satisfactorily; therefore, we began an investigation in 1936, in collaboration with Esau and Ahrens, in the Laboratory of the Technical Physical

We made preliminary experiments with waves from 2.73×10^7 to 1.2×10^9 Hz or from 11 meters to 25 cm. wave lengths. Since we had only 30 watts available for the shortest wave length, we used pieces of muscle and fat of about 3 c.c. which were placed in two chambers in series within a vessel made of trolitul. The results of these measurements made with an initial temperature of 18°C . are shown in Figure 1. The ordinate gives the ratio of temperature increase in fat to temperature increase in muscle; the abscissae represent the frequency or wave length and the circles indicate the mean of four measurements, the variations among which amounted to about 20 per cent. The measurements show that there is considerable decrease of the heating of fats with increasing frequency. For example, the value for the heating of fatty tissue decreased from 9 to 3.8 down to 2 if the wave length was changed from 11 meters to 1 meter and to 25 cm.

Later, I made numerous experiments on muscle-fat phantoms, which approximated the true body volumes in collaboration with regard to the size of phantom, arrangements of electrodes, position of glass-benzol thermometer, etc. Figure 3 shows

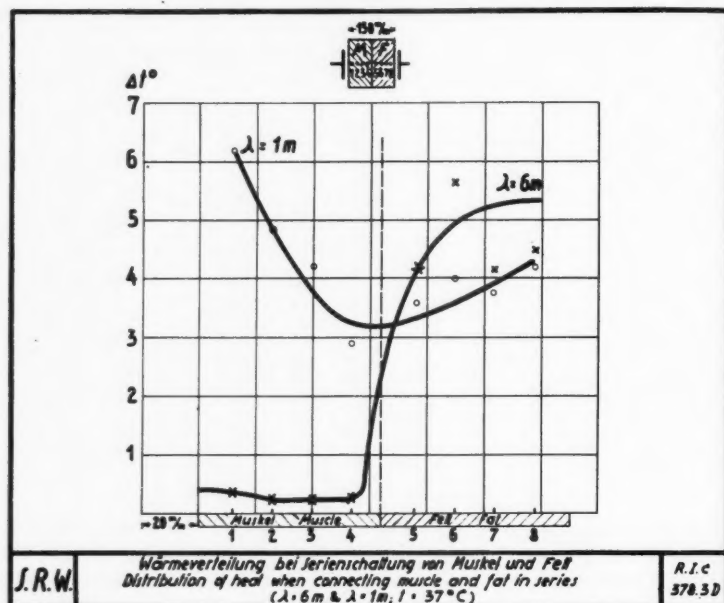


Fig. 4.

with Osswald, in the Laboratory of the Siemens-Reiniger Company. For this work, wave lengths of 6 meters and 1 meter, using various initial temperatures were employed. Lack of space does not permit a detailed description of the experimental set-up which is shown in Figure 2. The muscle-fat tissues were placed in a double-walled vessel made of trolitul and kept at body temperature throughout the experiment by blowing a warm current of air over the tissue; the muscle-fat phantom itself was placed in the thin-walled vessel of trolitul to prevent loss of tissue fluids.

In order to produce temperature increases of about 5° within a minute in the layer which was heated highest, we used a power of 200 watts while at a wave length of 1 meter, an initial power of 800 watts was available. The results of these measurements are shown in the next illustrations which also show important data in

the results of heating experiments on a cylindrical muscle-fat phantom. While the mean heating ratio of fat to muscle was of the order 16 to 1 at a wave length of 6 meters, it was found to be only 3 to 1 at a wave length of 1 meter. Figure 4 shows the results obtained for an initial temperature of 37° and for fat and muscle connected in series. All these measurements were made within an hour and a half after the animal (cow) had been killed.

In interpreting the results of these experiments, one must remember that actually the muscle layer always lies behind the fatty layer (as viewed from electrode) and that, therefore, the skin and subcutaneous fat usually lie within areas of greater field strength than muscle. This may explain the higher heating of muscle as compared with fat. Figure 5 shows the corresponding experiment with muscle and fat connected in parallel and measured at right-angles to the direction of the field.

These results are essentially the same as those demonstrated by our preliminary experiments. We should not expect too

electric constants on biological substances for wave lengths from 3 to 12 meters have furnished a quantitative basis which per-

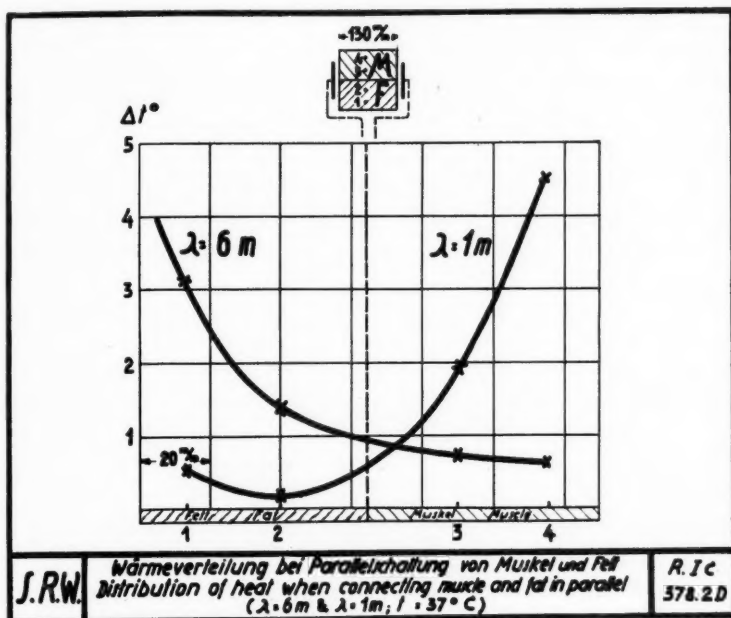


Fig. 5.

close numerical agreement of the values in the heating ratio in the different experiments since the readings are influenced by a number of factors which are difficult to control (arrangements of electrodes, placing of the thermometer, inhomogeneous fields, type of layer arrangement, irregular mixture of tissue, etc.). The parallelism of the heating ratio with that of the frequency and the temperature is of primary importance.

Of course, these phantom experiments are only a rough approximation of the actual conditions *in vivo*. Dead tissues lack the cooling effect of the circulating blood which naturally cannot be imitated in a physical experiment. However, these measurements do throw light upon the relationship of the heating of tissue at wave lengths of 6 meters and 1 meter.

Schaefer's measurements of conductivity in the ultra-short-wave field and Osswald's determinations of conductivity and di-

mits certain conclusions about the dependence of the heating of fat-muscle tissues upon the frequency which is employed.

The basis of the wave length dependence of the heating upon layers of different conductivities and dielectrical constants will not be discussed in detail; however, in this connection I should like to refer to my earlier papers in the *Zeitschrift für Hochfrequenztechnik*, 1930, and the *Zeitschrift für technische Physik*, 1932; to those of McLennan and C. C. Burton in the *Canadian Journal of Research*, 1931, and to that of Schaefer in the *Zeitschrift für experimentelle Medizin*, 1934, in which our original concept for special cases of extreme values of conductivity, dielectrical constants, was enlarged upon. This is of importance in regard to the layer arrangements of fat-muscle tissue.

I should like to call attention briefly to the fact that the optimal wave lengths for

fat and muscle, which result from the 45°-condition of conductivity and dielectric constant for maximum heating of several layers in series, are such that the optimal wave length for fat is greater than that for muscle; according to Osswald it is about 4 meters for fat and about 1.3 meter for muscle at about 37° C. For a two-layer system, fat-muscle, it follows that according to this theory of increasing frequencies, a considerable decrease of the relative heating of fat must occur. This agrees in principle with measurements of the heat distribution within the phantom.

At the present time it is impossible to state just what the change from six meters to one meter and its resulting considerable increase of the thermal deep dose means from a clinical point of view, but this question is being studied carefully. Since it is still very expensive to produce energies of several hundred watts at wave lengths of one meter, it can be used only in cases in which expert therapists believe routine short-wave treatment is unsatisfactory, as, for example, in massive heating of the female pelvis.

THE ROENTGEN DIAGNOSIS OF RETROCECAL APPENDIX

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MUCH has been written about the use of the roentgen ray in the diagnosis of appendicitis. Certain writers are of the opinion that a failure to obtain a filling of the appendix is pathog-

they do not represent the chief usefulness of the roentgen ray in this particular field.

The surgeon finds but little use for the x-ray in the diagnosis of appendicitis, except in those cases in which the symp-

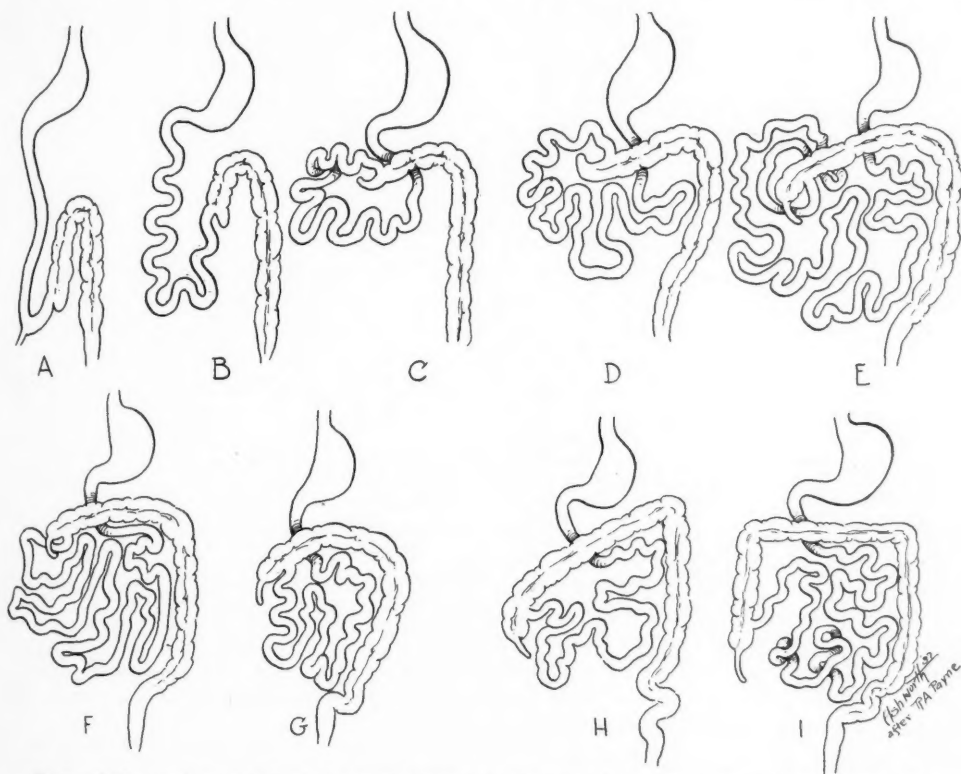


Fig. 1. Series of schematic figures illustrating stages in rotation of the intestinal tract. (From Huntington.)

nomonic of appendiceal pathology. Others have held that a patent lumen which readily admits the barium solution and permits a good filling of the appendix is not normal. Some place great stress upon a fragmented filling as an indication of pathology. Any and all of these points may be of value when properly fitted to other clinical and physical findings, but

toms do not clearly point to that diagnosis. Inflammatory pathology of the gall bladder, pelvic organs, or kidney occasionally simulates the symptoms of appendicitis and at times the reverse is also true. Congenital bands or other abnormalities, when present, may obscure the diagnosis and in such cases a roentgen examination will frequently reveal information of value,

by visualizing abnormalities and localizing the point of greatest tenderness.

Developmental rests of the cecum are a common cause of disturbed relationship in the right side of the abdomen and a hasty

small gut begins the forming of the primitive fold, while the large bowel is draped over it, in something approximating the later position. Next, the relative increase in the size of the body cavity permits the return of the gut. The small intestine is the first to return, and

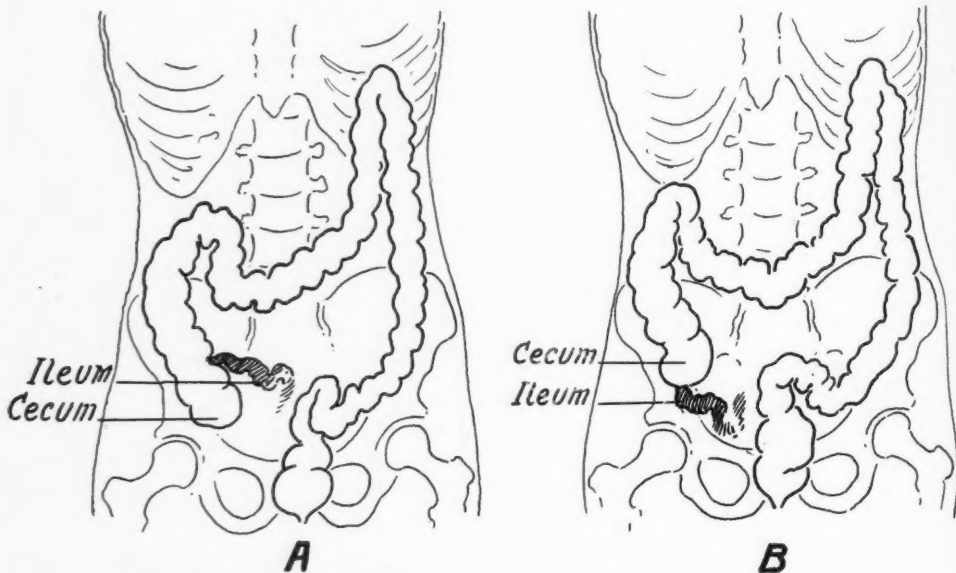


Fig. 2-A. Illustrating the normal relationship of the distal ileum to the cecum.

Fig. 2-B. Illustrating the apparent relationship of the ileum to the cecal tip when the ileocecal valve and appendix are in a retrocecal position. (Drawn by F. C. Trahar.)

review of the embryological changes in the development of the colon may be helpful in refreshing the memory. Payne and Trahar (1) have summarized these changes and this summary so aptly fits the present discussion that we can do no better than to quote from it.

"In Figure 1-A, we take up the position of the stomach and intestine at approximately the fifth week of fetal life. The primitive gut here lies in the mid-line, is attached to the umbilicus, and the cecum is beginning to show as a bud on the parietal portion of the gut. Two factors are prominent in later changes: first, the relative rapidity of the growth of the different parts of the gut, and second, the size of the other organs, particularly the liver, relative to the size of the body cavity.

"As the liver at this stage rapidly increases in size, the bowel is pushed out of the celom into the umbilicus. Here the rapidly growing

the large bowel follows, taking up the position shown in Figure 1-B, still later being pushed by the coil of the small intestine into the upper right quadrant (Figs. 1-C and 1-D). Attention should be drawn to the fact that, at this stage, the small intestine is entering from the right and above.

"*Rotation.*—The migration of the gut is now practically at an end. Figures 1-F and 1-G illustrate the next change, that of rotation resulting in the entrance of the small bowel on the inner side, or from the left and below.

"*Descent and Fusion.*—The real growth of the cecum begins at this stage, and in the later month of the fetal life, and the first month after birth, the growth of the organs carries it and the ileocecal valve into the right lower quadrant, and the fusion of the various mesenteries results in its final position (Figs. 1-H and 1-I)."

Failure to complete these various steps of development leads to the occasional

placement of the appendix in situations that may complicate the diagnosis if the appendix should become pathological and also may interfere with the customary surgical attack. It is in such cases that the roentgen ray can best aid the surgeon and render real assistance to the patient. Because the exact location of the appendix can be determined before operation, the surgeon can more accurately plan his attack and thereby reduce the shock and discomfort to the patient.

It is not the purpose of this paper to review all the technical procedures that are used in the roentgen examination of the appendix: these are well known to all. We do hope to lay stress upon the relationship of the distal ileum to the cecum, as observed radiographically, as an important diagnostic point.

The routine 12-hour meal oftentimes reveals the appendiceal outline, but it as often fails to give enough filling of the cecum to illustrate the presence or absence of rotation. Likewise, the opaque enema may give an excellent outline of the cecum, but fail to outline the appendix. In cases in which the appendix fills, the observer may draw fairly accurate conclusions, but when no outline is obtained the diagnosis must pass into the field of conjecture.

Figure 2-A illustrates the usual relation-

ship of the distal ileum to the cecum. The barium has completely filled the cecum and has passed into the distal ileum, which is seen to be attached on the medial side of the cecum. This illustrates a normal relationship between the ileum and cecum. In Figure 2-B, we find the ileum coming not from the medial side of the cecum, but appearing to come from the cecal tip. Attempts at manipulation fail to alter this appearance. When such a pattern is revealed we know that we are dealing with an incompletely rotated cecum and that the ileocecal valve and the appendix must be in a retrocecal position.

In our personal experience we have found this observation to be of great value in the diagnosis of retrocecal appendix. In certain cases it has been the only finding of any value in the roentgen diagnosis. During the past many years we have had occasion to follow a great number of these patients to surgery and have seen the accuracy of the observations demonstrated. We have come to look upon it as a pathognomonic sign, and, therefore, we feel justified in making it the basis of this report.

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METHODS USED TO ATTAIN HIGH SPEED IN ROENTGENOGRAPHY

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From the Research Laboratories, Westinghouse Lamp Division, Bloomfield, New Jersey

AN important problem in roentgenography is to obtain sharp shadowgraphs of moving objects, in particular of the heart and lungs in living persons. The solution of this problem involves taking roentgenograms with extremely short exposure times. By thus reducing to a minimum the blurring due to the motion of the object during exposure, the quality and detail of the x-ray film is greatly enhanced. The conventional way of decreasing exposure time is to increase the x-ray tube current (milliamperage) but there is a rather definite limit to which this can be carried. The limiting factors depend upon the rating of the x-ray tube focal spot and the load-carrying capacity of the supply line. Larger currents through the x-ray tube, even though applied only momentarily, require high voltage transformers with heavy windings to reduce ohmic resistance, and a supply line of large current-carrying capacity. Such heavy loads are generally limited to three phase systems.

The heavy loads and violent surges on the supply line and x-ray transformer can be eliminated by using condensers to store the energy required for making an x-ray shadowgraph. The condensers are charged slowly through rectifiers over an interval of several seconds, and then discharged rapidly through the x-ray tube in a small fraction of a second. The capacitance of the condenser must be such that sufficient energy is released in a single discharge to produce an x-ray film of satisfactory density. Since electrical energy is drawn from the supply line at a low rate, even small x-ray transformers suffice to charge a set of condensers for high speed roentgenography. Hence a small fluoroscopic x-ray unit may be converted into the most powerful roentgenographic machine.

Types of Controls Used to Discharge Condensers.—Perhaps the most simple method of discharging the condenser is through a sphere gap. With the x-ray tube filament set to emit a current of approximately 1,000 milliamperes, the condensers are charged to their predetermined voltage and then discharged through the gap. An appreciable amount of noise always accompanies the discharge, but due to the effective impedance of the x-ray tube being in the neighborhood of 80,000 ohms, it is not excessive. Even this noise is undesirable and unnecessary and would certainly frighten a patient unless the noise were muffled. An improvement is accomplished by immersing the sphere gap in an oil tank and closing the gap under oil. Silent operation can be obtained by using a vacuum switch to excite the x-ray tube. In this device (1) the separation of the electrodes is controlled by a magnetizing coil outside the vacuum chamber. These gaps withstand the total voltage of the transformer during the charging interval. Voltage is applied to the x-ray tube only during the discharge time. In some of the other methods to be described, the x-ray tube must effectively block the flow of electrons throughout the charging period.

The deleterious effect of the steep voltage wave front accompanying a condenser discharge is reduced to a minimum by adding a certain amount of inductance to the discharge circuit. Teillard (2) described a circuit containing an inductance of about 2,000 henrys. In addition to eliminating the steep wave front, this large inductance produced nearly constant potential during the time the x-ray exposure was being made.

A method of controlling the condenser discharge, reported by Bouwers (3), utilizes

a grid placed around the filament of an x-ray tube. A sufficiently negative bias is applied to this grid during the charging

tion current of 1,000 milliamperes, while that of the rectifier tube is capable of passing about twice this current. This is

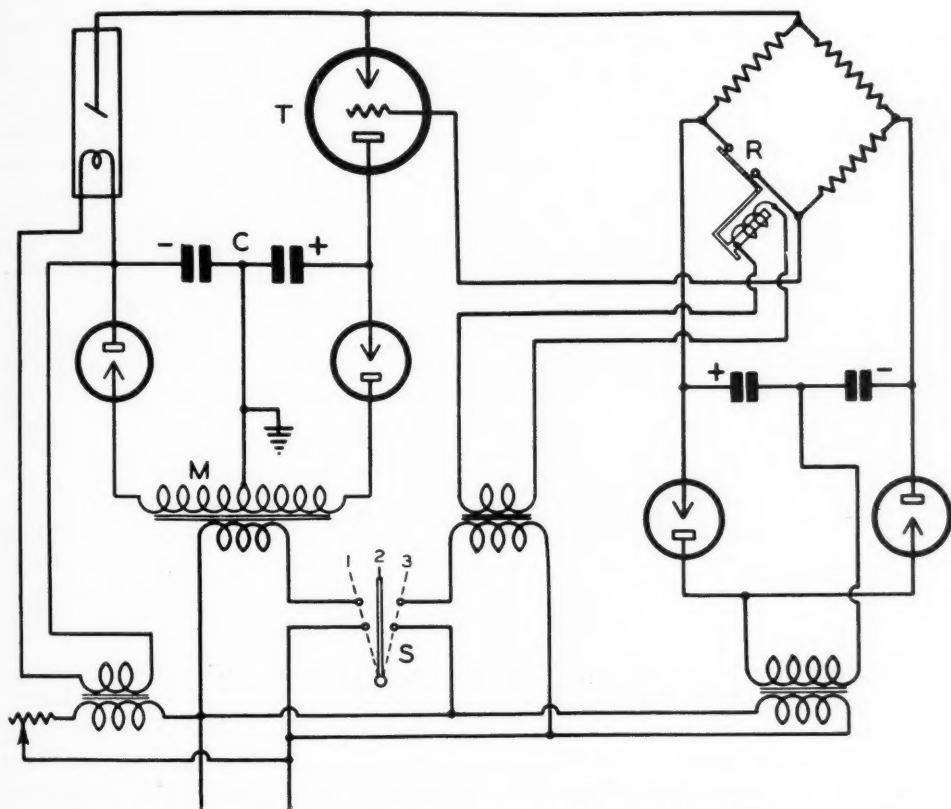


Fig. 1. Condenser discharge through the x-ray tube is controlled by a three electrode tube "T."

period so that very few electrons escape from the filament even though it is at full emitting temperature. To effect discharge, the negative bias is removed or the grid may even be made positive with respect to the filament. High voltage is applied to the x-ray tube during the charging interval as well as during discharge.

A more convenient way of accomplishing the same result is to introduce a grid-controlled rectifier in series with the x-ray tube and high voltage condensers. With this control tube, the circuit of which is described by Morrison (4), the filament of the x-ray tube is heated to give a satura-

necessary to reduce the voltage loss in the control or "trigger" tube to a small value and cause the x-rays to be generated within the x-ray tube. During the condenser-charging cycle a negative potential is applied to the grid of the rectifier tube, which effectively blocks the flow of electrons through both the control tube and the x-ray tube. After the condensers are fully charged an accelerating potential is applied to the grid which permits the passage of high currents through the x-ray tube with relatively low voltage loss in the control tube. The steepness of the wave front accompanying the condenser discharge is

controlled by the rate at which the grid potential is shifted from a negative to a positive value. The time required for

celerating potential applied to the grid of the "trigger tube" by the relay switch, R , causes the flow of electrons through the

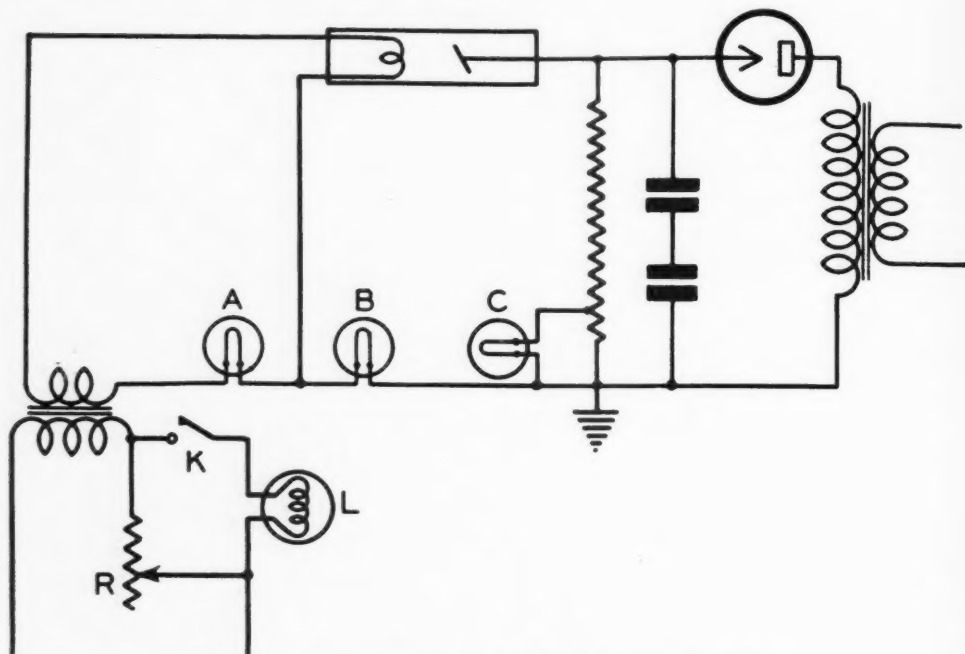


Fig. 2. Condenser x-ray machine with lamp filament control "L."

current to reach its maximum value is of the order of a few thousandths of a second. The time of condenser discharge depends upon the capacitance of the condensers, the voltage to which they are charged, and the rate at which electrons are emitted by the x-ray tube filament. This is of the order of from 0.02 to 0.10 second.

Figure 1 shows the electrical circuit of the condenser x-ray machine controlled by the "trigger tube." Closing the switch, S , to position, 1, causes a negative potential of several thousand volts to be applied to the grid of the control tube, T , while the main condensers, C , are being charged. In the neutral position, 2, the high voltage transformer, M , is disconnected from the supply line while a negative bias still prevents the discharge of condenser C . With the control switch in position, 3, an ac-

x-ray tube and the almost instantaneous generation of x-rays. The Wheatstone network associated with the biasing unit permits a change in polarity from negative to positive without opening the circuit to the control grid.

An interesting method of controlling the discharge of the condenser is given by Niemann (5), wherein no accessory equipment is required. The filament of the x-ray tube is maintained at such a low temperature during the time the condensers are charged that thermionic electrons are not given off. To discharge the condensers, part of the regulating resistance in the filament supply circuit is shorted out. This permits the filament to attain its predetermined electron-emitting temperature and so drain the charge of electricity from the condenser. Due to

the heat capacity of the x-ray tube filament, an appreciable time elapses before the maximum current is attained, and so the discharge time is quite appreciable.

A marked improvement in discharge time is obtained by a novel modification introduced by Ulrey (6). The principal features of this method are indicated in Figure 2. The high voltage transformer, rectifier tube, and condenser form the charging circuit. The discharge circuit consists of the x-ray tube and condenser. Oscillograph elements *A*, *B*, and *C* were introduced to observe photographically the transient phenomena occurring during the interval in which x-rays were produced. The filament-lighting transformer of the x-ray tube has a secondary winding of low ohmic resistance to permit over-shooting of the x-ray filament current. The regulation in the primary supply line consists of a nichrome wire resistor, *R*, and a tungsten filament lamp, *L*. Resistance *R* is of such size that the filament is heated below the electron-emitting temperature. The lamp filament *L* is so chosen that when the short circuiting key, *K*, is closed, the final current is such that the maximum predetermined electron emission is obtained from the filament of the x-ray tube. At room temperature the resistance of the tungsten filament in the control lamp is only about one-tenth its final value. Hence, when key, *K*, is closed, the momentary current through the x-ray filament is several times its final equilibrium value. This over-shooting of current heats the filament of the x-ray tube very rapidly and permits practically instantaneous x-ray exposures. The x-ray tube suffers no deleterious effect since the large filament current is applied only during the time the lamp filament *L* heats to its final temperature—a time of less than one second. The heat capacity of the filament is sufficient to reduce the steepness of the wave front of the condenser discharge so that violent surges do not appear in this circuit.

Several other methods might be used in discharging a condenser through an x-ray tube. One is to put an overload relay or a

fuse of proper size in the filament circuit of the x-ray tube and then overheat the filament by excessive voltage until the fuse opens the circuit. The size of the fuse is calculated to permit the filament to heat rapidly for a short time only, during which time the condenser is drained.

Dessauer (7) described a circuit in which a fuse was placed in the primary of the high voltage transformer that was momentarily overloaded. As soon as the fuse opened the circuit a heavy surge was passed through the secondary windings of the transformer and x-ray tube. This produced an instantaneous x-ray exposure. He used a gas-filled x-ray tube.

Another method is to pass the energy from a low voltage condenser through the x-ray tube filament. The momentary overheating of the filament will discharge the main condensers through the x-ray tube.

It is also possible to use a vapor- or gas-filled control tube in series with the x-ray tube and high voltage condensers. Tubes of the grid-glow or thyratron type might be adapted to high voltage use.

A magnetic field might be employed to confine the electrons from the filament to the cathode of the x-ray tube. At the desired moment the magnetic field is reduced to permit the normal flow of electrons through the x-ray tube. This scheme is very difficult to accomplish in a practical manner.

Data Obtained with an Oscillograph.—An oscillograph gives very desirable information on the speed and magnitude of the transient phenomena occurring during the discharge cycle. Much data can be obtained with a multi-element oscillograph on a single condenser discharge. The circuit of Figure 2 is used to illustrate the type of data obtained with an oscillograph. An element connected at *A* indicates the change in filament current, the element at *B* depicts the flow of current out of the condenser and through the x-ray tube, while an element connected as at *C* indicates the rate at which the voltage across the x-ray tube falls.

Figure 3 is a reproduction of an oscillogram record taken of conditions during discharge in the circuit of Figure 2. The filament current trace and in the tube current graph. The ripple in the latter trace is due to the intermittent heating of

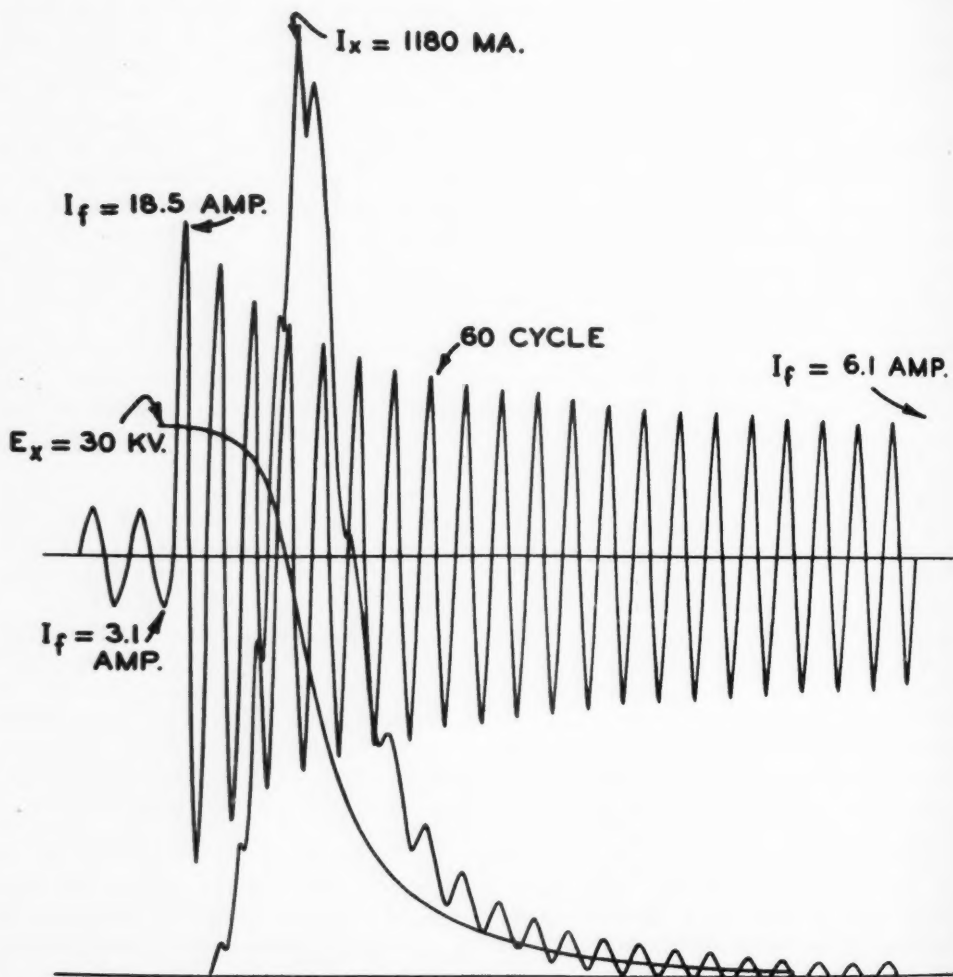


Fig. 3. Oscillogram record obtained from the circuit of Figure 2. The transient phenomena in filament current I_f , condenser voltage E_x , and x-ray tube current I_x are depicted.

x-ray tube filament current I_f changed from its steady state of 3.1 amperes to a maximum of 18.5 amperes, and then to a steady state of 6.1 amperes in an interval of less than one second. The condenser of 2 mf capacity was charged to 30 kv. (E_x) initially, and the maximum tube current (I_x) was 1,180 ma. The 60-cycle supply voltage is indicated both in the

the x-ray tube filament by the 60-cycle current.

The oscillograph applied to other circuits, indicated in the preceding paragraphs gives information showing characteristics of each of the control devices. For example, with the sphere gap, a high frequency surge accompanies the initiation of the discharge if there is insufficient

inductance in the discharge circuit. This surge places an excessive strain both on the x-ray tube and on the entire discharge

posure time. Since all the various schemes used in controlling the condenser discharge involve transient phenomena, the maxi-

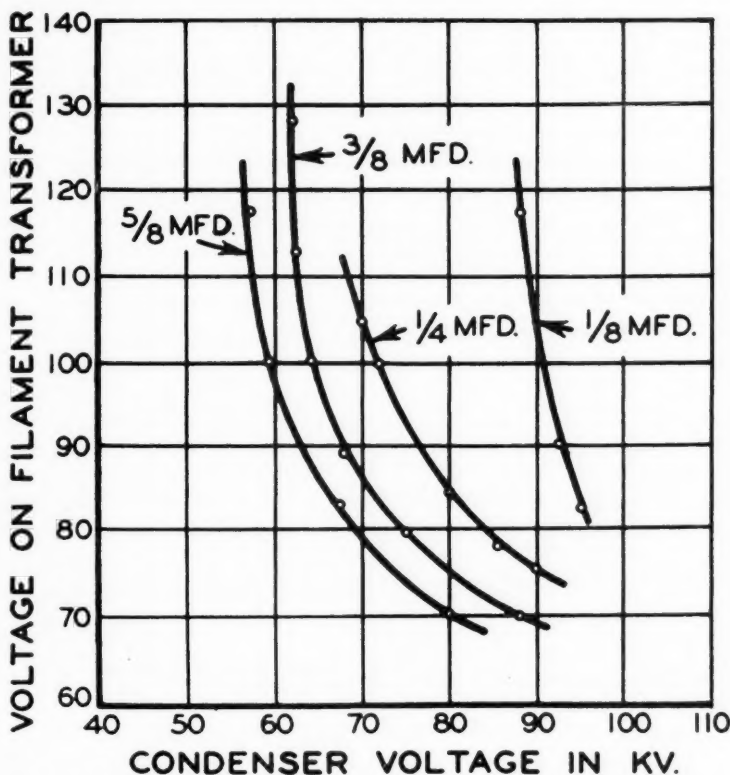


Fig. 4. Filament settings for stable operation of an experimental x-ray tube used in the circuit of Figure 2.

circuit. With the proper amount of inductance the current and voltage waves are smooth and free from high frequency oscillations. Bouwers (8) reports that with an inductance of 2,000 henrys the voltage wave is very round and broad at the top and gives nearly constant potential. Oscillograms readily show the difference in discharge time by substituting a tungsten lamp filament for nichrome wire resistance. Figure 3 shows an abrupt initiation of current through the x-ray tube, while if a nichrome wire resistor is substituted for the tungsten filament lamp, the increase in the tube current to its maximum value is slower and hence entails a longer ex-

pression time. Since all the various schemes used in controlling the condenser discharge involve transient phenomena, the maxi-

imum efficiency and proper operating conditions are best attained by use of the oscillograph. The speed of the condenser discharge in Ulrey's (6) method is controlled by changing the voltage applied to the filament-lighting transformer, once the fixed resistor and lamps have been selected. Different settings are necessary to compensate for variations in x-ray tubes having different sizes of focal spot, and for variations in the condenser capacitances. Figure 4 shows the relation between the voltage applied to the filament-lighting transformer and condenser voltage for various condenser capacitances. These curves in-

dictate the optimum operating conditions for one experimental x-ray tube. Actual chest films were taken with a condenser

proper thickness to regulate the maximum film opacity and by selecting a suitable speed of rotation for the disk, the records

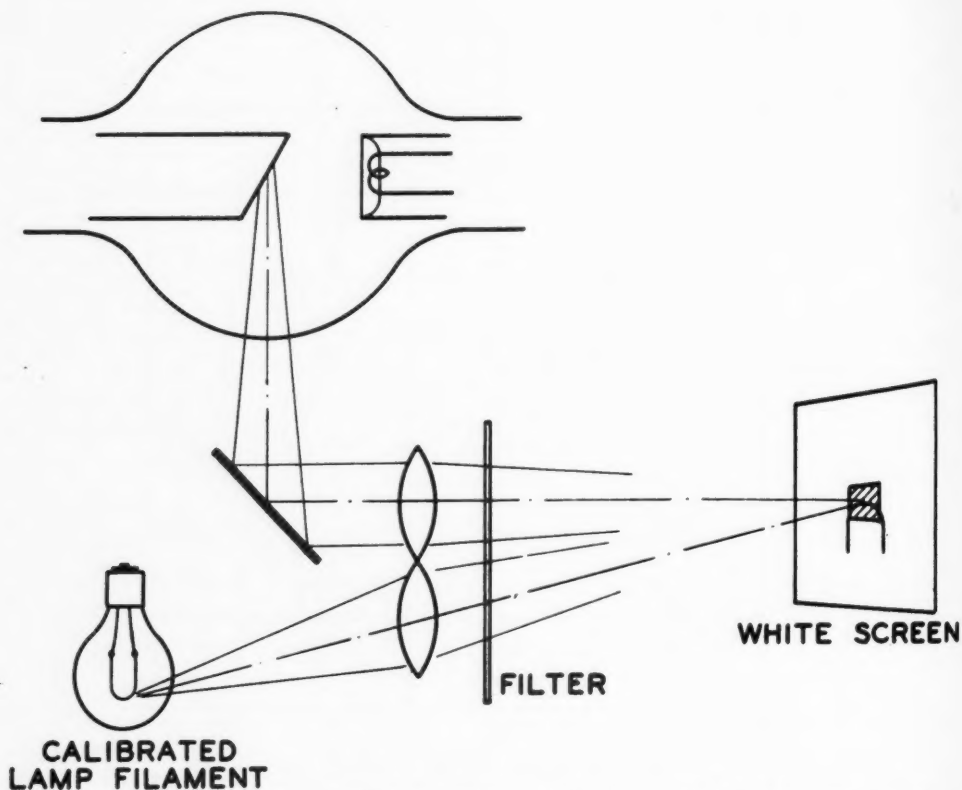


Fig. 5. Simple apparatus for matching the maximum instantaneous focal spot temperatures with a calibrated tungsten filament.

capacity of $\frac{1}{4}$ mf and voltages of from 60 to 70 kv. The quality of the roentgenographs was very good, the effective exposure time being about $\frac{1}{40}$ second.

Discharge Speeds Measured with a Rotating Disk.—Although the time of condenser discharge can be readily measured on the oscillograph records, a rapid and convenient method of making estimates of this quantity can be obtained with a rotating disk. A disk, one half of which is transparent to x-rays and the other half opaque, is caused to rotate above a photographic film during the condenser discharge. With an aluminum filter of

have one section completely transparent, one of maximum film blackening, and two sections showing a gradual shading of darkness to transparency. A certain amount of filtering is desirable to give the film a maximum density about equal to that of a diagnostic x-ray film. Too much filtering indicates too short an exposure time, while too thin a filter greatly exaggerates the effective condenser discharge time. By measuring the angle over which the gradation of film blackening is observable, one can calculate the speed of condenser discharge. A protractor is generally sufficient for approximate time de-

terminations, but a densitometer tracing made from the rotating disk record will give greater accuracy. Measurements of time made by the interval from initiation of discharge to some arbitrarily chosen point such as 95 per cent of maximum blackening give very uniform and comparable results.

Focal Spot Temperature Measurements.—Even though the time of x-ray exposures can readily be determined with an oscillograph or rotating disk, it is very necessary to know that the maximum temperature of the focal spot of the x-ray tube anode never exceeds about $3,000^{\circ}\text{K}$. Otherwise, excessive evaporation of tungsten or actual melting takes place. Observations on the temperature of the focal spot can be made by projecting the image of the focal spot on a screen together with an adjacent image of a calibrated tungsten filament. The momentary flash on the anode registers its temperature in comparison to that of the calibrated lamp. Figure 5 indicates the simplicity of this measurement. A red filter intercepting the light from both light sources makes color temperature comparisons very easy.

CONCLUSION

The chief advantage of using condenser discharges in roentgenography is the reduction of blurring caused by motion. This results in increased sharpness of detail. Other desirable features, such as uniformity of film density in successive exposures, are obtained because exposure timers are eliminated. With a relatively small x-ray transformer, and power lines of low capacity, one can do roentgenographic work equivalent to that done with the largest commercial x-ray machines.

It is a pleasure to acknowledge the assistance of Dr. C. T. Ulrey, with whom some of the experimental work was done.

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RESULTS OF RADIATION THERAPY IN PRIMARY OPERABLE RECTAL AND ANAL CANCER¹

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RESULTS following the use of roentgen and radium rays in primary operable rectal and anal cancer depend largely upon selection of cases for this type of treatment and upon dosage and technic of application of the physical agents. Experience has proven that radiation therapy is suitable for a fair percentage of operable cancers as well as for the inoperable stages of disease. It should be recognized that at the present time irradiation is not a suitable method for routine employment in all operable cases. Until there is additional improvement in the technic of application of the physical agents, surgical resection will be required in over 50 per cent of the operable cases, largely because of inaccessibility and extent of the local disease.

Patients with operable tumors may be separated, as to the type of treatment, into three main groups: (1) cases suitable for radiation therapy alone, colostomy being occasionally required for relief of obstructive symptoms; (2) cases suitable for radical surgery by one of the proven methods of technic, and (3) cases most benefited by the combined use of irradiation and radical surgery. The combined treatment has its greatest field of usefulness in advanced operable stages of disease. Treatment of the latter two groups need not be considered in this communication.

Selection of cases for clinical cure by irradiation is of vital importance. Early recognition, while the cancer remains small and the disease localized, is the greatest asset to successful radiation therapy. A high percentage of the very small lesions can be successfully treated by this method. A number of medium and large-sized tumors may also be favorably influenced,

but the percentage of suitable cases with well-established or far-advanced operable disease will be lower than in the group of early lesions. The degree of infiltration into the submucous and adjacent tissues must be carefully considered in all cases. Increased difficulty in adequately applying radon is encountered when infiltration is extensive, diffuse, and poorly localized. Cancers, to be favorable for this type of treatment, must be sufficiently accessible for approach with a suitable instrument so that the size, shape, degree of infiltration, etc., can be estimated in relation to radium applications. Badly infected tumors or those with miliary or large abscesses are to be avoided. Severe local and constitutional reactions with sloughing of the tumor mass may occur when a large amount of radon is inserted into a badly infected tumor.

Various methods of applying the physical agents have been advocated. The method which appears most suitable for operable rectal and anal cancer consists of external irradiation in all cases, in combination with the use of either (1) gold-filtered non-removable radon seeds, or (2) local applications administered by way of the rectum with specially constructed applicators. In a few cases, in order to facilitate the two latter procedures, redundant polypoid areas of cancer tissue are removed with an electric snare after completion of external therapy.

External irradiation, which is the first step of treatment, consists of administering roentgen and radium rays through six portals about the circumference of the pelvis. When the tumor is low in the rectum, or involves the anal canal, a perineal field is included. The size of the portals about the pelvis are sufficiently restricted so as not to overlap. Applications are given daily, and the total skin dosage to each por-

¹ Presented before the Fifth International Congress of Radiology, in Chicago, Sept. 13-17, 1937.

tal is kept within the tolerance of the skin. Roentgen rays constitute the greater portion of external therapy. In a small

apy is completed. This short period of waiting permits an improvement in the general condition of the patient and al-

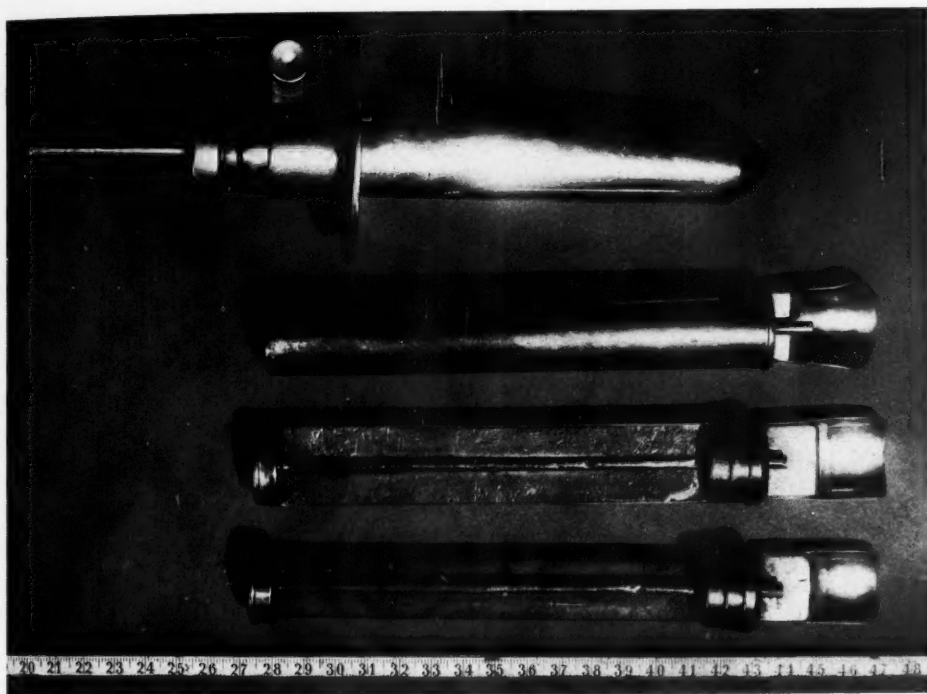


Fig. 1. Rectal applicator with three radium holders. The holders vary in the amount of lead used in protecting the rectal mucosa. The applicator is similar to a proctoscope but with a movable shoulder.

number of cases a combination of roentgen and radium rays, given externally, has constituted our treatment.

External radium irradiation is administered by a four-gram radium pack at 15.0 cm. from the skin. In the series of cases to be reported upon, the dosage and technic of roentgen-ray therapy has been changed from time to time. At present we are using 200 kv. at 70 cm. target distance with a filter of 1 mm. of aluminum and 0.5 mm. of copper. Treatments are given daily with the dosage varying from 0.5 to 0.75 of a skin erythema. Such dosage permits the treatment to be completed in from two to three weeks.

Interstitial applications of gold seeds are given about two weeks after external ther-

apies further favorable changes to take place in the tumor mass. Seeds varying in strength from 1.0 to 2.5 millicuries are employed. A total dosage of radon sufficient to devitalize all malignant cells is inserted at one time. This dosage will vary, depending upon the size and radiosensitivity of the tumor, from 1,000 to 5,000 millicurie-hours. It is impossible to over-emphasize the importance of appropriate distribution of the seeds, for success or failure depends largely upon this factor. Anesthesia is seldom required, as the insertion is usually painless. Seeds are inserted with long trocar needles, usually by direct vision, through an electrolighted proctoscope, the operative field being kept clean by means of a suction-

tube. Occasionally, with low-lying tumors, the insertion is made blindly by the sense of touch, with the finger within the rectum to guide distribution.

Local rectal applications consist of ap-

holder, containing a number of radon tubes in tandem fashion, sufficient to extend 0.5 cm. above the upper limits and 0.5 cm. beyond the lower limits, is inserted and fixed in position. The radium is

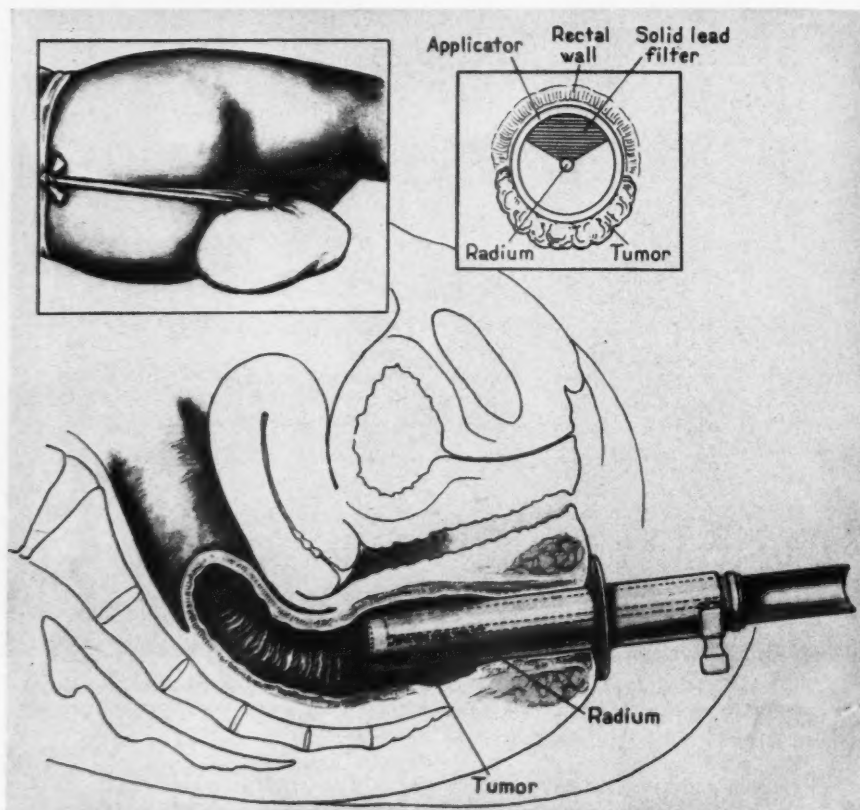


Fig. 2. Rectal applicator in position, radium being administered at 1.25 cm. from the tumor. Insets: applicator held in position; cross-section showing radium with lead filter protecting one-third of the rectal circumference.

plying radon or radium at from 0.75 or 1.25 cm. from the surface of the tumor by means of special rectal applicators. This method has been employed in a small number of the cases here reported. Applicators are fashioned similar to the ordinary proctoscope. They are placed in position by direct vision, or blindly, after careful measurements as to location and size of the tumor have been determined. When the applicator is placed in position the obdurator is withdrawn, and the

filtered by 2 mm. of brass. The section of the circumference of the rectum not invaded by tumor is protected by an additional filter of lead, the thickness of which corresponds to one-half the diameter of the applicator. Applications are given daily. The daily dosage appearing most effective varies from 100 to 250 millicurie-hours. Total dosages vary from 2,000 to 5,000 millicurie-hours and require from three to six weeks for completion. The use of fractional dosages of radon to the surface

of the tumor is still in its infancy. More time and an increased number of cases will be required before the true worth of this method can be definitely determined.

Colostomy is seldom required when ra-

perior to those obtained in 1925, when gold-filtered radon seeds were first employed in the treatment of this disease.

Personal Cases.—From 1925 to 1935, inclusive, 65 so-termed operable cases have



Fig. 3. Roentgenogram of pelvis following the implantation of gold seeds into a small rectal cancer.

diation therapy is employed in primary operable lesions. Only when obstruction is a troublesome factor, due either to disease or secondary contraction of indurated tissue, need the operable patient be subjected to this procedure. During the early years of treatment considered in this report colostomy was done in about 50 per cent of all cases, but during the past five years it has seldom been employed.

RESULTS

The results so far obtained by radiation therapy in operable rectal cancer are encouraging. Present-day results appear su-

been treated by this method. During the same period, 119 patients were subjected to radical surgery. Of the 65 patients treated by radiation therapy, there were 37 males and 28 females. Six of these patients refused radical surgery and 12 patients were classified as very poor surgical risks. Local disease was extensive in 21 cases and in 12 of these the condition had reached the advanced borderline operable stage.

It is quite evident from this review that the best results are obtained in early operable lesions. In the series of 65 cases, there were 19 large, 28 medium, and 18

small tumors. A large tumor signifies advanced disease with varying degrees of fixation, medium sized tumors represent well-established disease, with or without moderate degrees of fixation, while small tumors vary in size from 1 to 4 cm. in diameter and are freely movable.

Of the 19 patients with advanced disease, 12 are dead and seven are alive. Of the 12 patients who died, two were considered to be free and ten were thought to have cancer at the time of death. Of the seven patients living, two are thought to have disease, while five are considered to be clinically free of disease. One of the living patients has remained well for two years while the other four have enjoyed freedom from disease for periods varying from five to nine years.

Results from the treatment of medium-sized tumors have been somewhat more encouraging. Of the 28 cases treated, there have been 16 satisfactory results to date. Eighteen of the 28 cases are dead, while ten are alive and clinically free of disease. Treatment of six of the patients was quite satisfactory; they have since died, three of them of intercurrent disease without recognizable cancer, one year eleven months, four years, and six years, respectively, after treatment. The status of disease in the fourth patient at the time of death, five years eight months after treatment, is unknown. The fifth patient lived six years and eight months, dying with lung metastases without local recurrence. The sixth patient, who refused surgery, was free of disease for five years and six months.

The most gratifying results to date have been with the small tumors, of which there were 18 subjected to irradiation. Three of these patients are dead. One died three years after treatment with metastases in the liver, without recognizable cancer in the rectum. Another died ten years after treatment, at the age of 84, and the third lived seven years and died without recognizable cancer in the rectum. The remaining 15 patients are alive and considered clinically free of disease, the periods of

freedom varying from 15 months to 10 years.

Sufficient time has not elapsed to afford a definite determination of the final results of radiation therapy in a large series of operable rectal cancer. However, more than five years have elapsed since 34 of the above patients were treated. In this group of 34 cases, radiation therapy was supplemented by colostomy in 18 instances (53 per cent), while 16 patients were not subjected to any form of surgery. Seventeen of the 34 patients (50 per cent), survived the five-year period; nine of them are still alive and clinically free of disease, five and one-half to ten years later. Three of those not living died of intercurrent disease without any evidence of their original condition. The length of life of those now dead varied from three months to ten years.

In the remaining 31 cases which have been treated by radiation therapy within the five-year period, colostomy was employed in only three instances, or less than 10 per cent. Eight of the 31 patients are dead; one dying of intercurrent disease, and seven with cancer. Twenty-three are alive, 21 of whom are considered clinically free of disease, the periods of freedom varying from one year three months to four years six months.

CONCLUSIONS

Radiation therapy, with our present technic of application, occupies an important position as a selective method of treatment for operable rectal cancer. It is capable of producing long-standing clinical cures, and is suitable for large, medium, and small lesions. The highest percentage of good results is obtained in the early localized cancers. The advantages afforded by this method of treatment are: (1) short periods of hospitalization, (2) avoidance of the dangers and inconveniences of radical surgery, and (3) the retention, in most instances, of a normally—or practically so—functioning rectum.

CARCINOMA OF THE CERVIX: MORTALITY REDUCTION¹

By WRIGHT CLARKSON, M.D., and ALLEN BARKER, M.D., Petersburg, Virginia

CANCER of the cervix accounts for nearly 20 per cent of all deaths from cancer in women; and our observations agree with those of Norris (1), who thinks that a cross-section of all cases of carcinoma of the cervix will show five-year survivals of not over 10 per cent. When one considers the fact that five-year survivals of well over 50 per cent have been reported following proper radiological treatment of large series of moderately advanced cases, it becomes obvious that the number of deaths can be greatly reduced by more effective application of our modern methods of treatment.

Inadequate knowledge of cancer and geographic inertia afflict both the average physician and the general public. The only way to meet this condition seems to be to bring trained oncologists and facilities for treatment to as many localities as possible. This could well be accomplished by the formation of numerous small rotating clinics. Through close co-operation with the local medical societies everywhere, clinics can carry cancer control to the laity and to the physicians. These clinics should be conducted only by those who are thoroughly trained in the diagnosis and treatment of neoplastic diseases. The establishment of cancer clinics stimulates the demand for specialization in oncology and there is no field of medicine where intense specialization is more urgently needed.

A definite cancer diathesis is inherited by many persons, and this is one of the chief causes of the present death rate from this disease. Genetics, therefore, may eventually play an important rôle in the prevention of cancer. It is also possible that some day there will be discovered a way of increasing an individual's resistance to this

disease by inoculation or otherwise; but no material reduction of mortality seems likely to occur from either of these methods in the very near future.

Our present methods of prophylaxis and treatment of cancer of the cervix, however, are practicable and comparatively effective, and the mortality rate can be materially lowered if we combine the educational factors with the scientific aspects of the problem. Women everywhere must be taught to regard leukorrhea and any other unusual change in the character or amount of their vaginal discharge as significant of some abnormal condition which demands immediate investigation and treatment. Physicians must be impressed with the necessity for making frequent and careful examinations of the cervix as a routine procedure; and both laymen and physicians must be convinced of the fact that cancer patients can be properly treated only by those who are thoroughly trained in oncology.

Since a benign disease of the cervix usually precedes actual cancer of the cervix, every physician should be on the outlook for abnormal conditions of this structure, and the lesions should be diagnosed accurately and treated promptly.

Among the methods that have been used in the treatment of precancerous conditions of the cervix, electric coagulation has been found the most effective, and in carefully selected cases, in women at or about the menopause, external irradiation to the pelvis is a valuable aid. In view of our present knowledge of the action of the ovarian hormones, it is reasonable to believe that pelvic irradiation, properly administered, is also a good prophylactic measure against cancer of the body of the uterus and against cancer of the breast.

Of utmost importance in the treatment of all neoplasms is the fact that cancer

¹ Presented before the Fifth International Congress of Radiology, Chicago, Sept. 13-17, 1937.

usually, if not always, begins as a local disease, and that it kills seldom by direct extension but more often by metastases. The trauma which necessarily accompanies any forceful physical examination, biopsy, or other operation, may favor this transplantation; and it is logical to believe that properly irradiated malignant cells are less likely to form metastases, should they be so disseminated.

Although the importance of pre-operative irradiation seems to be well established, its value is not fully appreciated by many physicians who regularly make forceful bimanual pelvic examinations under anesthesia, take biopsy sections, dilate and curette the malignant uterus, and then force a radium capsule into place with no attempt to give the patient irradiation prior to these traumatizing operations.

In older women, non-traumatic irradiation should be given in the form of roentgen therapy, but in young women, sufficient pre-biopsy irradiation can be given by using a lead protector in which a thinly filtered radium pack is brought in close contact with the tissue to be removed.

The old saying that ten cents' worth of radium may do a million dollars' worth of injury is figuratively true, but this warning seems not to have been effective. Radium is widely heralded to-day as a great blessing to patients with cancer, particularly to those with cancer of the cervix. But in reality, it is being so frequently misused in the treatment of this condition that, at present, the number of patients who are needlessly rendered incurable by radium therapy is far greater than is the number of patients being cured by the treatment.

The treatment of cancer of the cervix is now generally conceded to be essentially a radiological problem, but surgeons and other physicians untrained in the science of radiology are treating far more of these cases than are qualified radiologists. Therefore, it is necessary to make it more widely known that effective irradiation cannot be expected more than a few centimeters away from the point of radium application, that malignant cells become radio-

resistant when so inadequately irradiated, and that curable cancers are often thereby rendered hopeless.

By properly combining roentgen and radium therapy, Coutard (2) and his co-workers have obtained striking results in the treatment of their cases. They report five-year cures of 75 per cent in the early cases, degree I; 56 per cent in the moderately advanced cases, degree II, and 36 per cent in the far advanced cases, degree III.

Most competent radiologists are now using some quite similar methods of external irradiation followed by prolonged intra-cavitary radium therapy, but the fact that some aspects of the treatment are surgical in nature, that hundreds of unattached surgeons own radium, and that the giving of roentgen irradiation prior to the radium therapy considerably increases the expense of the treatment, all greatly complicate the problem, and often prevent the employment of the best method of treatment. This makes it desirable to establish numerous endowed cancer clinics with proper personnel and equipment for the modern treatment of cancer of the cervix.

SUMMARY

1. Five-year survivals of all cases of carcinoma of the cervix treated to-day do not exceed 10 per cent, yet five-year survivals of well over 50 per cent may be obtained by the proper use of external irradiation as the first act, followed by proper intra-cavitary irradiation.

2. Travelling cancer clinics working in co-operation with local medical societies should carry cancer control to the laity and to physicians.

3. Women everywhere should be taught to seek medical advice early for all abnormal vaginal discharges, physicians should be taught to make frequent and more careful examinations of the cervix, and both the laity and physicians should be taught that cancer of the cervix can be properly treated only by oncologists.

4. Electric coagulation and irradiation, in selected cases, are effective in the treatment of precancerous lesions of the cervix.

5. Non-traumatic irradiation should be given prior to all forceful examinations and biopsies, and prior to the intra-cervical use of radium.

6. Radium is so frequently misused today that the number of cancer of the cervix patients who are rendered incurable thereby is far greater than the number being cured by radium therapy.

7. The economic factor makes desirable the establishment of numerous endowed clinics for the treatment of cancer of the cervix.

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CASE REPORTS AND NEW DEVICES

A NOTE ON SHOCK-PROOF TUBES IN LOW VOLTAGE THERAPY

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The introduction of a new type of x-ray equipment always raises the question of x-ray intensity and quality of the new as compared to the old equipment. In the case of the new G. E. SP 1-4 shock-proof unit and the old G. E. Universal type tube, it can be said that the intensity and quality of the x-rays from them are different, but the biological reactions of equal doses in roentgens are clinically alike.

The permanent filter of the SP 1-4 shock-proof unit is greater than the permanent filter of the Universal tube. X-ray quality, and therefore depth intensities, depend on not only filtration but also wave-forms of the applied voltage. Comparisons of the x-ray emissions should therefore be based on tests of the tubes with the same high tension generator.

In September, 1936, the department of Dermatology at the Peiping Union Medical College replaced a Universal type tube with an SP 1-4 shock-proof unit. The half-wave high tension generator was continued with the new unit. Immediately preceding and following the exchange of tubes, measurements of intensities and half value layers were made in air by means of a Fricke-Glasser dosimeter. The results are recorded in Table I (see below).

The intensity of x-rays from the shock-proof unit is from 40 to 50 per cent higher than the radiation intensity of the Universal type tube when all other factors are identical. Half value layers without filter are approximately equal.

Dermatological results in the past year and a half with the shock-proof unit are similar to the previous clinical results with the Universal tube. Epilation and threshold skin erythema of approximately equal duration and degree are produced by equal doses in roentgens. Depth intensities were not measured.

CARCINOMA OF THE PANCREAS

By HYMAN S. ABRAMS, M.D., *Tuscaloosa, Alabama*

Roentgenologic diagnosis of pancreatic tumor is less favorable, especially in early stages, than of similar lesions in other structures and organs. Much information is, however, possible by thorough investigation. A typical picture pathognomonic of pancreatic tumor does not exist. The signs are chiefly indirect and consist of deformities and defects of surrounding organs. These include increase in the dimensions of the normal curve formed by the second portion of the duodenum, dilatation of the stomach or duodenum, temporary or permanent defects in the stomach or duodenum, and displacement of the stomach and transverse colon in some cases. Attention should be given to the presence of relative fixation of the hepatic flexure or gall bladder. A fixed position of the former has also been observed in carcinoma of the gall bladder and may constitute the only roentgen evidence of disease in this region of the abdomen, especially if the examination is limited.

There is likewise no clinical syndrome characteristic of carcinoma of the pancreas and tests of pancreatic function are very often of no diagnostic value. The symptoms may vary from those of psychoneurosis, vague gastro-intestinal dysfunction with or without jaundice, to those of peptic ulcer or gall-bladder disease. Even in advanced stages, there may be nothing more than a general decline in health.

The size of the pancreas as seen at operation or that of a palpable mass is not always evidence of the true extent of the pathologic changes. It is, therefore, very important to consider the possible presence of this lesion even in those instances in which it is least suspected. The foregoing statements are well exemplified by two cases encountered recently.

The first is that of a white male 44 years of age, who complained of generalized muscle

TABLE I See Nurnberger, above

(70 kv. peak; 10 ma.: mechanical rectification: large focus)

Filter	Universal Tube			Shock-proof Unit		
	S.T.D.	r/min.	Half value layer ¹	S.T.D.	r/min.	Half value layer ¹
0	25 cm.	203	0.58 mm. Al	21 cm.	205	0.62 mm. Al
1 mm. Al	25 cm.	60		21 cm.	84	
2 mm. Al	25 cm.	32		21 cm.	50	

¹ Half value layers were read from absorption curves in aluminum.

pain, most marked in the calf muscles, for about six or seven years. His chief complaints, however, were daily afternoon rise

after administration of the opaque, a collection of barium about 1.5 cm. in diameter was noted in the region of the second portion of the

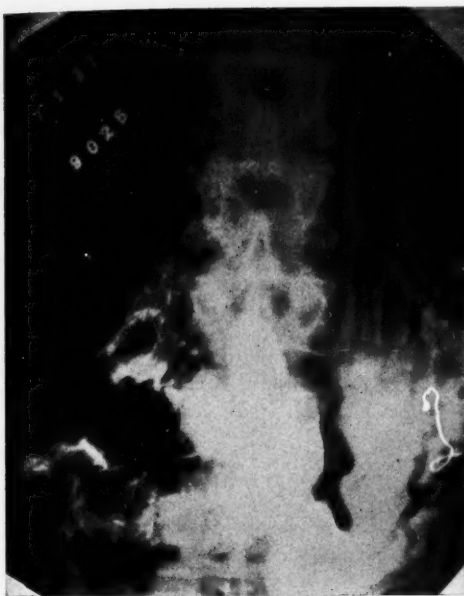


Fig. 1.

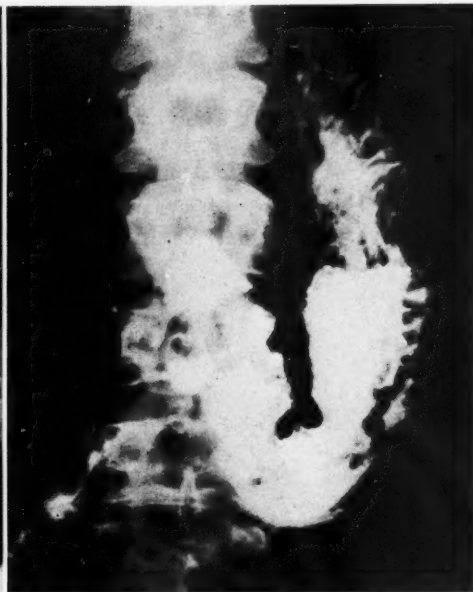


Fig. 2.

Fig. 1. Demonstrates increased gastric peristalsis and dilatation of the second portion of the duodenum.

Fig. 2. Roentgenogram, taken two hours after ingestion of the opaque meal, shows the *transient* pseudo-diverticulum in the region of the second portion of the duodenum close to the pylorus.

in temperature followed by profuse perspiration and a loss of 14 pounds in weight in six weeks. About four months after onset of illness he complained of almost continuous dull, general, abdominal pain, vomiting, poor appetite, constipation, weakness, extreme nervousness, and insomnia. He was noted to be melancholy, became upset easily, and developed a state of anxiety.

Physical examination revealed a poorly developed and undernourished individual. There was slight tenderness on deep palpation over the abdomen. He had slight fever, mild tachycardia, and chronic bilateral catarrhal otitis media. Results of routine and special laboratory examinations were negative except for a persistent leukocytosis which averaged 17,000.

Roentgenological study of the gastro-intestinal tract revealed moderately active gastric peristalsis, delayed passage of the opaque into the duodenum, and moderate gastric residue at five hours. The second portion of the duodenum was slightly dilated (Fig. 1). Relative fixation of the hepatic flexure of the colon was noted. Because of these findings, a modified fractional study was done. Two hours

duodenum and close to the pylorus (Fig. 2). This was believed to be a pseudo-diverticulum and not to be confused with the usual type of pouching, at times encountered in this area. The possibility of carcinoma of the pancreas was suggested. Operation was not believed advisable because of the poor condition of the patient. The total white blood cell count became 24,900 and a severe secondary anemia developed. He became weaker and expired about eleven months following onset of illness.

Necropsy revealed that the head of the pancreas was slightly firmer than the remainder. There was a firm, round mass about 3.5 cm. in diameter with slight irregular contour adherent to the under surface of the distal portion of the second part of the duodenum. This duodenal segment looped over the mass mesially. Cut surface showed solid tissue believed to be carcinoma. The histologic diagnosis was adenocarcinoma of the pancreas with metastases. Metastatic lesions were noted in the liver, spleen, duodenum, kidneys, myocardium, and in a lymph node.

Several aspects of this case make it noteworthy. The clinical features, especially at

the beginning, were rather vague. The importance of psychoneurotic tendencies is not to be underestimated. The existence of

Roentgen study of the gastro-intestinal tract revealed slight cardiospasm. A large mass with fairly regular, semilunar-shaped upper



Fig. 3.

Fig. 3. Shows the large mass with fairly regular, semilunar-shaped upper surface and displacement of the stomach.



Fig. 4.

Fig. 4. Demonstrates widening of the rugæ and defects in the cardia and pars media of the stomach.

metastases with apparently slight gross involvement of the pancreas, as seen in this case, is of much importance. A pseudo-diverticulum, perhaps better termed a *transient* pseudo-diverticulum—may give evidence of the existence of pathologic changes in the region of the head of the pancreas.

The second patient was a white male, 47 years of age, who complained of a cramping pain in the left lower abdomen which radiated to the back. His appetite was poor, and he had lost about 30 pounds in weight in the past month. He stated that two weeks ago he had severe cramping in the lower abdomen and nausea following a heavy meal.

Physical examination revealed a well developed individual weighing 156 pounds (71.8 kg.). There was abdominal tenderness and a questionable tumor mass was palpated.

Laboratory examinations were negative except that gastric analysis revealed red and white blood cells, marked excess of mucus, a total acidity of 14, and no free hydrochloric acid.

surface was noted in the region of the cardia and pars media of the stomach. It was visible through the magenblase and displaced the stomach forward and to the left (Fig. 3). The stomach tube glided over the shadow of the mass. There was, however, no obstruction. The gastric rugæ appeared widened and there were defects in the region of the cardia and pars media (Fig. 4). Although some of this was apparently due to pressure by the mass, it was believed from roentgen examination that there was infiltration of the stomach. The stomach was fairly mobile and there was no localized gastric tenderness. Increase in the normal curvature of the second portion of the duodenum was noted.

Operation revealed a large, firm, nodular mass in the tail and body of the pancreas. This was separated easily from the stomach. The liver contained a few nodules. The examination was otherwise essentially negative. The diagnosis was carcinoma of the tail and body of the pancreas, with metastasis to the liver.

The post-operative course was stormy, and the patient expired on the third post-operative day, apparently as a result of pulmonary embolism. Examination of a piece of tissue removed at operation revealed fat and chronic inflammation.

SUMMARY AND CONCLUSIONS

1. Two cases of carcinoma of the pancreas are reported.
2. The importance of psychoneurotic tendencies is not to be underestimated.
3. Much information is often possible by thorough roentgen examination. Fractional study may often add findings not discovered in the routine examination of the gastrointestinal tract.
4. Transient pseudo-diverticula may give evidence of the existence of a lesion in the region of the head of the pancreas.
5. The size and gross appearance of the pancreas is not always indicative of the true extent of the pathologic changes. Metastasis to the myocardium occurred in one of the cases reported.

CULTIVATION AND CLINICAL APPLICATION OF *ALOE VERA* LEAF

By ARCHIE FINE, M.D., and SAMUEL BROWN, M.D., Cincinnati, Ohio

From the Tumor Clinic and the Department of Roentgenology, respectively, Jewish Hospital

Recent reports in the literature by Collins and Collins (1) and Wright (2) advocate the use of *Aloe vera* leaf in the treatment of radiation injuries. Our experience, though rather limited, leads us to concur in the opinions expressed by these writers. However, we have found that supplies of the leaf at times are difficult to procure, and in the case of indigent patients, to be so expensive as to limit or forbid its use. We decided to investigate the possibility of cultivating the plant so as to have an abundant and cheap source always at hand.

Aloe vera is a member of the family of *Liliaceae*, with a large number of representatives which are difficult to differentiate. It is a tropical or semitropical plant, native to northern Africa and southeastern Europe, and is much esteemed for its curative properties. We had considerable difficulty in obtaining a plant, for, although many florists offered us samples, none was the variety desired. It is suggested that before purchase, the plant be identified by a qualified botanist. We finally were able to obtain a specimen from the city conservatory.

The leaves are pale yellowish-green, flecked with white spots, with small thorns at the borders, the green becoming darker as the leaves



Fig. 1. *Aloe vera* plant. Note the small plants growing from suckers at the base.

become older. New plants develop by suckers from the roots. While the plant can be cultivated in one's home, it is our impression that a greenhouse, in which the temperature is more equable and the humidity fairly constant, is preferable. The plants require little attention, and too much water should be avoided. The soil preferably should be porous; a coarse sandy loam to which some manure has been added seems to be adequate. New plants can be procured quickly by leaving the original plant undisturbed in a small pot, as this tends to hasten the production of suckers. The latter, when large enough, are separated from the original plant and replanted. Leaves are cut away with a sharp knife close to the stem. The leaves keep fairly well if covered with wax paper and kept in a cool atmosphere not below 50 or above 70 degrees.

The method of clinical application has been amply described by others, but for the sake of completeness, it will be described here briefly. The leaf is cut to the size and shape of the lesion. The flat outer covering is trimmed away with a sharp knife, exposing the transparent greenish-yellow pulp which is crisscrossed by several knife cuts so as to cause the leaf to "bleed." The jelly gradually dries out or is absorbed, and at this time is replaced by a fresh leaf. Another method is to scrape the

jelly from the leaf, apply it to the lesion, and keep it in place with wax paper or oiled silk dressing until it dries out or is absorbed. Clinically, we have used it in several cases following intensive radiation in order to assist healing, and we have found epithelization to be hastened. In addition, one case of skin atrophy following x-ray therapy to the face, many years ago, was very much benefited. We have noted in those cases which are receiving prolonged courses of therapy whereby the skin is becoming irritated and painful, though intact, that application of the leaf is extremely soothing, and allays the discomfort considerably. This was noted especially in breast cases in which the axilla received a large amount of radiation and became quite painful.

Interesting enough, the gardener in charge of the greenhouse informed us that he had cultivated *Aloes* more than fifty years ago in Europe and was well acquainted with the

plant's value in the treatment of pruritic skin lesions.

SUMMARY

1. The method of cultivating *Aloe vera* plant is described.

2. Clinical observation suggests that the leaf is of value in treating radiation injuries.

We wish to express our thanks to Messrs. Garnish and Stewart, of the Eden Park Conservatory, who were kind enough to furnish us with a specimen of *Aloe vera*.

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- (1) COLLINS, C. E., and COLLINS, C.: Roentgen Dermatitis Treated with Fresh Whole Leaf of *Aloe vera*. Am. Jour. Roentgenol. and Rad. Ther., **33**, 396, 397, March, 1935.
- (2) WRIGHT, C. S.: *Aloe vera* in Treatment of Roentgen Ulcers and Telangiectasis. Jour. Am. Med. Assn., **106**, 1363, 1364, April 18, 1936.

HOSPITAL-PHYSICIAN RELATIONS IN ENGLAND

Precedents established in what many Americans still refer to affectionately as the "Mother Country" have frequently determined decisions applied to contingencies which arise in America many years after they have appeared in England. Historians can point to scores of developments in social and economic growth to illustrate the fact. A conspicuous instance is the enactment of so-called "social" legislation and labor laws which saw their beginning in the British "New Deal" more than twenty years before they became a subject for political debate in America.

While all such precedents cannot be said to have resulted to the advantage of America, it must be obvious that the Britisher and the American are of a common ilk, and the British Isles have proven a convenient testing ground for many principles in political economy and sociology subsequently adopted or rejected in the United States.

There is currently considerable confusion in medical and hospital circles concerning the relationships between hospitals and physicians in the delivery of medical services under the American system of medical practice. There is a strong and mutual desire to achieve a solution that will protect the hospital, guarantee proper care to the patient, and assure the unshackled progress of medical science and practice.

Does England, in her more mature age, provide any aids toward solution? A recent Statement of Policy adopted by the British Medical Association may well offer valuable help to American hospitals and medical men in their efforts to find mutually desirable principles for the practice of medicine in hospitals. The policy of the British Medical Association will be of peculiar interest to the radiologist. As the American hospital gradually extends its functions into the practice of medicine, it is his specialty that has felt the first untoward effects of such a trend. How has the problem of radiologic practice in the hospital been solved in England? Do hospitals in England engage in the practice of radiology, or do radiologists there carry on a private practice in the hospital as do other medical specialists?

Many of the questions that have engendered heated debate between hospital superintendents and practitioners of the diagnostic specialties are conclusively answered in an interesting little booklet containing the policy of the British Medical Association. The whole question of physician-hospital relations is covered in the statement which is apparently a binding regulation upon British hospitals.

As in America, there are two kinds of hospitals in England—private and governmental. The private hospitals are voluntary general hospitals, like ours, while the governmental institutions include both charity hospitals maintained by local governments and special sanatoria. The Statement of Policy adopted by the British Medical Association is meant to define the respective domains of these two types of institutions and to determine the arrangements under which physicians shall practise their profession in each.

In the beginning the Statement recognizes that care of the poor shall be rendered in "Council Hospitals" corresponding to our county and city charity institutions. It is recommended that the staffs in these institutions be paid on a full or part time basis by the hospitals from funds derived from tax sources or insurance funds. Every patient admitted to these hospitals is expected to pay something toward his care if his pecuniary status permits. Membership in "contributory" or insurance plans entitling the wage earner to hospital care in the Council hospitals is restricted to those of very low income. Physicians working in the hospital are to be remunerated by the hospital either by fixed salary or by payment for definite services and responsibility. The Statement recommends the creation of a "central clearing bureau" for the admission of charity patients to the Council hospitals in each community.

"Voluntary hospitals," says the Statement, "have become increasingly the hospitals of the worker and his dependents." That class which composes the bulk of private practice in this country is customarily hospitalized in private nursing homes where physicians appointed to the visiting staff carry on their practice precisely as they do in office consultation. The

Council and Voluntary hospitals serve much the same type of patients and for this reason the British Medical Association recommends the extension of "contributory schemes" for the payment of hospital expense for these low income patients. Likewise it is recommended that, in view of the great charity load placed upon the staffs of Voluntary hospitals, physicians be remunerated for their part time services.

On this subject the Statement says, "It is certain that local authorities must continue in their council hospitals some system of paid medical staffs, whether whole or part time. If the voluntary hospital system is to persist and even more if demands for expansion are to be met, the visiting staffs must be paid on a like basis. Every extension of hospital service diminishes the field of private practice open to consultants and specialists, and economically it is no longer possible largely to increase the numbers of these practitioners without making definite provision for reasonable remuneration for their hospital work."

The British Medical Association permits no ambiguity in its use of the terms "hospital care" and "medical care." "Medical treatment," according to its official document, "includes any and all of those services which can be and are rendered by a registered medical practitioner, e.g., examination whether clinical or laboratory. . . ." There is thus no opportunity to regard radiology, pathology, etc., as a part of hospital care instead of medical care.

In the case of private patients above the income scale admitting them to membership in the contributory schemes, physicians rendering services under the above definition are to be paid on a fee-for-service basis by the patient. Out-patient Departments in the hospital are to be closed to all except charity patients and those who can pay, either privately or from insurance plans, shall have consultations or specialist services provided by the private practitioner in his office or the home.

Hospital insurance schemes should not, in the opinion of the British Medical Association, be conducted by the hospitals themselves on a service contract basis as they are in this country, but should be organized by committees entirely independent of the hospital. Payments to the hospital for hospital care should be on a cash basis and no insurance risk should be carried by the hospital.

The inclusion of any kind of medical care, which, under the definition quoted above,

would include radiology and pathology, in hospital insurance plans is definitely disapproved by the Statement of Policy. "The method of remuneration for medical services to be payment for work done, on the terms customary for such patients in each area," it says.

That section of the Statement of Policy pertaining to the practice of radiology in hospitals is of such exceptional interest that the pertinent portions of it are reprinted herewith in full:

"2. A hospital should require payment of fees from patients attending for radiological services, except from those who are members of a contributory scheme which provides such services or from those who come within the category of 'Free Patients.' *An agreed share of such fees, or an agreed honorarium, should be placed at the disposal of the medical staff and the radiological department should not be managed in such a way as to make a profit for the hospital by the exploitation of the professional services of the visiting radiologists.*

"3. A hospital may on the advice of the visiting radiologist arrange a schedule of modified charges for radiological services for patients within the scale of income limits, and based upon an average of one-half the fees commonly charged for similar private work in the district; but the schedule so arranged should not be published or exhibited publicly.

"4. A hospital situated in a district where there are qualified medical practitioners carrying on in private the practice of radiology should not provide for any patient able to pay private fees radiological services, except such as in the best interests of the patient can only be obtained in that institution.

"5. A hospital in a district where there is no other radiologist than the radiologist to the hospital may allow this officer to receive, directly from private practitioners, private patients who shall pay fees not less than those charged in private for similar cases in similar districts, and the radiologist should receive not less than two-thirds of the fees so paid, provided always that all costs incurred by the hospital be covered.

"6. Radiological services for statutory authorities (e.g., Ministry of Health, National Health Insurance, Municipal Bodies, etc.) should ordinarily be arranged to be supplied in private by private practitioners. Where such arrangements must be made with a hospital, the fees payable for the service shall be upon a scale approved by the Association. The radiologist's report shall be given in every case.

Of the fee paid not less than two-thirds should go to the radiologist for his opinion, and the remainder to the hospital to cover costs.

"9. The hospital almoner or other proper officer should certify the suitability of patients for admission and should assess and collect all payments from patients, *but the right should be reserved to the visiting radiologist to receive direct the fees for medical services to private patients.*

"10. *Fees for services to patients in pay beds should be paid to the visiting radiologist in each individual case according to the service rendered, less an agreed proportion to the hospital to meet costs.*"

This is encouraging news from abroad. With a subsidence of the acrimony that has unfortunately characterized many of the debates on hospital-physician relations in the past, there is every reason to hope for a sound and satisfactory solution to the problems surrounding the practice of radiology in American hospitals.

The American Hospital Association indicated a willingness to be guided by the principles of organized medicine in making contemporary adjustments, when it adopted a resolution at its recent annual meeting, stating that it was prepared to approve "periodic payment plans for hospital care and medical service in hospitals which are also approved by the local medical profession." What constitutes medical care and what constitutes hospital care is a question to be determined "by hospitals and the local profession."

Continued co-operation and friendly conference between organized hospitals and organized radiologists should produce a solution in this country as it has in England, acceptable both to hospitals and medical men.

MAC F. CAHAL
Executive Secretary

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Chicago, Illinois

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section? Please send such information to Leon J. Menville, M.D., 1201 Maison Blanche Bldg., New Orleans, La.

CALIFORNIA

California Medical Association, Section on Radiology.—*Chairman*, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles; *Secretary*, Carl D. Benninghoven, M.D., 95 S. El Camino Real, San Mateo.

Los Angeles County Medical Association, Radiological Section.—*President*, John F. Chapman, M.D., 65 N. Madison Ave., Pasadena; *Vice-president*, E. N. Liljedahl, M.D., 1241 Shatto St.; *Secretary*, Merl L. Pindell, M.D., 678 South Ferris Ave.; *Treasurer*, Henry Snure, M.D., 1414 Hope Street. Meets every second Wednesday of month at County Society Building.

Pacific Roentgen Club.—*Chairman*, Lyell C. Kinney, M.D., San Diego; *Secretary*, L. Henry Garland, M.D., 450 Sutter Street, San Francisco. Executive Committee meets quarterly; Club meets annually during annual session of the California Medical Association.

San Francisco Radiological Society.—*Secretary*, L. H. Garland, M.D., 450 Sutter Street. Meets monthly on first Monday at 7:45 P.M., alternately at Toland Hall and Lane Hall.

COLORADO

Denver Radiological Club.—*President*, F. B. Stephenson, 452 Metropolitan Bldg.; *Vice-president*, K. D. A. Allen, M.D., 452 Metropolitan Bldg.; *Secretary*, E. A. Schmidt, M.D., 4200 E. Ninth Ave.; *Treasurer*, H. P. Brandenburg, M.D., 155 Metropolitan Bldg. Meets third Tuesday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—*Chairman*, Ralph T. Ogden, M.D., 179 Allyn St., Hartford; *Secretary-Treasurer*, Max Clinman, M.D., 242 Trumbull St., Hartford. Meetings twice annually in May and September.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

Florida Radiological Society.—*President*, H. O. Brown, M.D., 404 First National Bank Bldg., Tampa;

Vice-president, H. B. McEuen, M.D., 126 W. Adams St., Jacksonville; *Secretary-Treasurer*, J. H. Lucinian, M.D., 168 S. E. 1st St., Miami.

GEORGIA

Georgia Radiological Society.—*President*, James J. Clark, M.D., Doctors Bldg., Atlanta; *Vice-president*, William F. Lake, M.D., Medical Arts Bldg., Atlanta; *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Prather Clinic, Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—*President*, David S. Beilin, M.D., 411 Garfield Ave.; *Vice-president*, Chester J. Challenger, M.D., 3117 Logan Blvd.; *Secretary-Treasurer*, Roe J. Maier, M.D., 7752 Halsted St. Meets second Thursday of each month, September to May, except December.

Illinois Radiological Society.—*President*, Cesare Gianturco, M.D., 602 W. University Ave., Urbana; *Vice-president*, Fred H. Decker, M.D., 802 Peoria Life Bldg., Peoria; *Secretary-Treasurer*, Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—The next meeting will be May 2, 3, 4, 1939, to be held in Rockford. The officers of the Section for the coming meeting are Harry B. Magee, M.D., of Peoria, *Chairman*, and Warren W. Furey, M.D., 6844 Oglesby Ave., Chicago, *Secretary*.

INDIANA

Indiana Roentgen Society.—*President*, Stanley Clark, M.D., 108 N. Main St., South Bend; *President-elect*, Juan Rodriguez, M.D., 2903 Fairfield Ave., Fort Wayne; *Vice-president*, A. C. Holley, M.D., Attica; *Secretary-Treasurer*, Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—*Chairman*, Whitmer B. Firor, M.D., 1100 N. Charles St.; *Secretary*, Walter L. Kilby, M.D., 101 W. Read St. Meetings third Tuesday of each month.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—*President*, Sam W. Donaldson, M.D., 326 N. Ingalls St., Ann Arbor;

Vice-president, Clarence Hufford, M.D., 421 Michigan Ave., Toledo, Ohio; *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave.

Michigan Association of Roentgenologists.—President, E. R. Witwer, M.D., Harper Hospital, Detroit; *Vice-president*, D. W. Patterson, M.D., 622 Huron Street, Port Huron; *Secretary-Treasurer*, C. K. Hasley, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—President, Walter H. Ude, M.D., 78 S. 9th St., Minneapolis; *Vice-president*, Leo G. Rigler, M.D., University Hospitals, Minneapolis; *Secretary-Treasurer*, Harry Weber, M.D., 102 Second Ave., S. W., Rochester. Meetings quarterly.

MISSOURI

The Kansas City Radiological Society.—President, L. G. Allen, M.D., 907 N. 7th St., Kansas City, Mo.; *Secretary*, Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Paul C. Schnoebelen, M.D.; *Secretary*, W. K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—President, T. T. Harris, M.D., Clarkson Memorial Hospital, Omaha; *Secretary*, D. Arnold Dowell, M.D., 117 S. 17th St., Omaha. Meetings first Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *President*, Frank E. Wheatley, M.D., 520 Beacon St., Boston; *Secretary*, E. C. Vogt, M.D., 300 Longwood Ave., Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, Milton Friedman, M.D., 31 Lincoln Park, Newark; *Vice-president*, P. S. Avery, M.D., 546 Central Ave., Bound Brook; *Secretary*, W. James Marquis, M.D., 198 Clinton Ave., Newark; *Treasurer*, James Boyes, M.D., 744 Watchung Ave., Plainfield. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by president.

NEW YORK

Brooklyn Roentgen Ray Society.—President, Albert Voltz, M.D., 115-120 Myrtle Avenue, Richmond Hill; *Vice-president*, A. L. L. Bell, M.D., Long Island

College Hospital, Henry, Pacific, and Amity Sts., Brooklyn; *Secretary-Treasurer*, E. Mendelson, M.D., 132 Parkside Ave., Brooklyn. Meetings first Tuesday in each month at place designated by president.

Buffalo Radiological Society.—President, Walter Matlack, M.D., 101 High St.; *Vice-president*, Chester Moses, M.D., 333 Linwood Ave.; *Secretary-Treasurer*, J. S. Gian-Franceschi, M.D., 610 Niagara Street. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen-ray Society.—President, W. E. Achilles, M.D., 60 Seneca St., Geneva; *Vice-president*, M. T. Powers, M.D., 250 Genesee St., Utica; *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings held in January, May, and October as called by Executive Committee.

Long Island Radiological Society.—President, Samuel G. Schenck, M.D., Brooklyn; *Vice-president*, G. Henry Koiransky, M.D., Long Island City; *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn; *Treasurer*, Louis Goldfarb, M.D., 608 Ocean Ave., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, Raymond W. Lewis, M.D., 321 E. 42nd St., New York City; *Vice-president*, Henry K. Taylor, M.D., 667 Madison Ave., New York City; *Secretary*, Roy D. Duckworth, M.D., 170 Maple Ave., White Plains; *Treasurer*, Eric J. Ryan, M.D., St. Luke's Hospital, New York City; *Member of Executive Committee*, E. Forrest Merrill, M.D., 30 W. 59th St., New York City. Meetings third Monday evening each month at Academy of Medicine.

Rochester Roentgen-ray Society.—Chairman, Joseph H. Green, M.D., 277 Alexander St.; *Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

Associated Radiologists of New York, Inc.—President, Albert L. Voltz, M.D., 115-120 Myrtle Ave., Richmond Hill; *Vice-president*, M. M. Pomeranz, M.D., 911 Park Ave., New York City; *Secretary*, W. J. Francis, M.D., 121 Madison Ave., New York City; *Treasurer*, Theodore West, M.D., United Hospital, Port Chester. Meetings first Monday evening each month at McAlpin Hotel.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast Line St., Rocky Mount; *Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Cleveland Radiological Society.—President, John Heberding, M.D., St. Elizabeth's Hospital, Youngstown; *Vice-president*, R. V. May, M.D., St. Luke's Hospital, Cleveland; *Secretary-Treasurer*, Harry Hauser, M.D., City Hospital, Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—President, B. M. Warne, M.D., Doctors Building, Cincinnati; *Secretary-Treasurer*, Justin E. McCarthy, M.D., 707 Race St., Cincinnati, Ohio. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—President, Charles S. Caldwell, M.D., 520 S. Aiken Ave., Pittsburgh; *First Vice-president*, Thomas L. Smyth, M.D., 111 N. 8th St., Allentown; *Second Vice-president*, Reuben G. Alley, M.D., Western Pennsylvania Hospital, Pittsburgh; *Secretary-Treasurer*, Lloyd E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect*, Louis A. Milkman, M.D., 212 Medical Arts Bldg., Scranton; *Editor*, William E. Reiley, M.D., Clearfield. Annual meeting, May, 1939. Exact date and place to be decided.

Philadelphia Roentgen Ray Society.—President, Thomas P. Laughery, M.D., Germantown Hospital; *Vice-president*, Elwood E. Downs, M.D., Jeans Hospital, Fox Chase; *Secretary*, Barton H. Young, M.D., Temple University Hospital; *Treasurer*, R. Manges Smith, M.D., Jefferson Hospital. Meetings first Thursday of each month from October to May, Thompson Hall, College of Physicians, 19 S. 22nd St., 8:15 P.M.

The Pittsburgh Roentgen Society.—President, William B. Ray, M.D., 320 E. North Avenue, N. S. Pittsburgh; *Secretary*, Harold W. Jacox, M.D., 4800 Friendship Ave. Meetings held second Wednesday of each month at 4:30 P.M., from October to June at various hospitals designated by program committee.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—President, Percy D. Hay, Jr., M.D., McLeod Infirmary, Florence; *Secretary-Treasurer*, Hillyer Rudisill, Jr., M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee State Radiological Society.—President, S. S. Marchbanks, M.D., 508 Medical Arts Bldg., Chattanooga; *Vice-president*, Steve W. Coley, M.D., Methodist Hospital, Memphis; *Secretary-Treasurer*, Franklin B. Bogart, M.D., 311 Medical Arts Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—President, Jerome H. Smith, M.D., San Antonio; *President-elect*, C. F. Crain, M.D., Corpus Christi; *First Vice-president*, M. H. Glover, M.D., Wichita Falls; *Second Vice-president*, G. D. Carlson, M.D., Dallas; *Secretary-Treasurer*, Henry C. Harrell, M.D., 517 Pine St., Texarkana. Meets annually. Temple is place of next meeting.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Radiological Society of Virginia.—President, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president*, L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary*, V. W. Archer, M.D., University of Virginia Hospital, Charlottesville.

WASHINGTON

Washington State Radiological Society.—President, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Secretary*, T. T. Dawson, M.D., Fourth and Pike Bldg., Seattle. Meetings fourth Monday of each month at College Club.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary, H. W. Hefke, M.D., Milwaukee Hospital, Milwaukee. Meets monthly on first Friday.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor*

HOWARD P. DOUB, M.D., *Associate Editor*

METASTASIS

Metastasis is the plague of malignancy. It is stealthy in its travel, because, so frequently, there is a total absence of pain. The initial lesion may not be in physical evidence or detectable by methods of precision. In fact, only a thorough postmortem investigation will disclose the primary lesion, which may be as small as a pin-head, although the metastatic involvement is extensive.

The roentgenologist, diagnostically and therapeutically, is able to make a definite contribution. He must have a comprehensive understanding of metastatic phenomena. The surgeon or internist may direct attention to the sites of predilection, but the roentgenologist, as a clinician and consultant, must direct attention to other areas. What is most needed is not a detailed description of isolated cases, but a general survey, a basis of rationalizing a given case.

The problem cannot be reduced to a common denominator. When one considers that malignant neoplasms may be disseminated by the venous, arterial, or lymphatic systems; by arterio-venous communication; by direct extension; by drop metastases; by retrograde permeation; can pass from the lesser to the greater circulation through the pulmonary capillaries, and from the lymphatic to the venous circulation; that great differences in various tumors and the same tumor, all present their own predilection, and finally, that most tumor emboli are autolyzed and never take root, it gives one such an awareness of the complexities as to make possible only limited generalities.

Various contributors dealing with metastatic processes have made casual mention of a higher incidence in skeletal and pulmonary manifestations since the advent of thorough roentgenographic studies. Careful autopsy examination alone cannot give us an accurate estimate of the incidence of skeletal metastases. Nor can the roentgenographic findings without

pathological confirmation serve as an entirely dependable criterion. Certainly the primary site frequently remains a mystery to the roentgenologist; therefore, roentgenological and pathological correlation is essential.

From the viewpoint of radiotherapy it is incumbent upon the therapist to know the various lymph channels. The distance separating malignancies from the terminal vessels is the distance from the blood stream. In other words, when malignant cells reach the central lymph vessels they will soon be emptied into the blood stream.

To illustrate the varied and devious lymph pathways, those concerned with the breast serve as a good example: the major outflow goes directly to the anterior axillary group, thence to the central group. There are, however, other groups of vessels by which the lymph may pass from the breast. It may pass to the interpectoral glands, then to the infraclavicular group; the lymph may pass directly into the infraclavicular glands. It may also drain in the skin into the supraclavicular glands. The vessels may also pierce the chest wall to the internal mammary glands along the costo-sternal margin. The opposite breast also receives lymph, and some of the lymphatics pass between the seventh rib and xyphoid process and pierce the abdominal wall to the extra-peritoneal space. The glands themselves serve as barriers, however: sometimes those farther from the original lesion are involved, those in closer proximity having been completely avoided.

A hypernephroma is a good example in which the metastatic involvement of a remote area will be the first signal of serious pathology; unfortunately, the primary tumor will receive no clinical consideration until blood is present in the urine and until a palpable mass also is present, the usual symptom-complex having been absent or minimal during the interim.

Since all these vagaries are incidental in the presence of a malignancy, the medical profession should insist that, at least, a lateral roentgenogram of the head, a postero-anterior roentgenogram of the chest, and a roentgenogram of the pelvis be taken routinely before any major operative procedure, regardless of age and regardless of whether or not a malignancy is present. It has been found that metastatic processes may exist; also, by the nature of their distribution, location, and density a

proper inference can be made as to their probable origin; whether lymphangitic or hematogenous in distribution; whether osteoplastic or osteoclastic in nature. Their presence should influence the kind and degree of therapeutic intervention, for it is our obligation to guard the welfare and best interests of the patient and avoid undesirable or unnecessary procedures.

M. J. HUBENY, M.D.

ANNOUNCEMENTS

THE AMERICAN BOARD OF RADIOLOGY

The next examination to be conducted by The American Board of Radiology will be in St. Louis, May 11 to 14, 1939. Those contemplating appearing for examination at that

time should file their applications with the Secretary by February 1, if possible.

A new Registry of the Diplomates of The American Board of Radiology will be published early in 1939. Any changes of address since the publication of the last Registry should be sent immediately to the Secretary's office.

Following is a list of those who have been certified during 1938:

Name	Address	Field
1. Anderson, William K.	Saginaw, Mich.	Roentgenology
2. Apple, Elbert D.	Greensboro, N. C.	Radiology
3. Ashbury, Howard H.	Elkins, West Va.	Therapeutic Radiology
4. Athle, Laxman H.	Bombay, India	Roentgenology
5. Baird, Lester W.	Temple, Tex.	Radiology
6. Barden, Robert P.	Pittsburgh, Pa.	Radiology
7. Barker, Hiram O.	Alexandria, La.	Roentgenology
8. Belair, Joseph F.	Washington, D. C.	Roentgenology
9. Bell, Dorothy	New York, N. Y.	Therapeutic Radiology
10. Bell, J. Sheridan	New York, N. Y.	Radiology
11. Benninghoven, Carl D.	San Mateo, Cal.	Roentgenology
12. Bogart, Franklin B.	Chattanooga, Tenn.	Radiology
13. Borrelli, Frank J.	New York, N. Y.	Radiology
14. Bowen, Albert	Fort Sam Houston, Tex.	Roentgenology
15. Briggs, Rowland S.	San Francisco, Cal.	Radiology
16. Brooks, Edward C.	Montreal, Canada	Diagnostic Roentgenology
17. Bullitt, James B.	San Jose, Cal.	Radiology
18. Butler, Frank E.	Portland, Ore.	Roentgenology
19. Connelly, Marie L.	Chicago, Ill.	Roentgenology
20. Cotton, Albertus	Baltimore, Md.	Diagnostic Roentgenology
21. Curtis, Richard C.	Corsicana, Tex.	Roentgenology
22. Dirkse, Paul	Peoria, Ill.	Radiology
23. Disbrow, G. Ward	Summit, N. J.	Diagnostic Roentgenology
24. Dobbs, William G. H.	New Haven, Conn.	Radiology
25. Dwyer, Maurice F.	Seattle, Wash.	Radiology
26. Earl, David M.	Iowa City, Ia.	Radiology
27. Epstein, Bernard S.	Brooklyn, N. Y.	Diagnostic Roentgenology
28. Ettinger, Arthur	New York, N. Y.	Diagnostic Roentgenology
29. Farber, George J.	Baltimore, Md.	Radiology
30. Fierstein, Jacob	New York, N. Y.	Diagnostic Roentgenology
31. Fine, Archie	Cincinnati, O.	Radiology
32. Foley, Sydney I.	Flint, Mich.	Radiology
33. Ford, Glenn R.	Endicott, N. Y.	Roentgenology
34. Golan, Myer E.	New York, N. Y.	Radiology
35. Goldberg, Henry	New York, N. Y.	Therapeutic Radiology
36. Gonzalez-Martinez, Isaac F.	San Juan, P. R.	Radiology
37. Gray, Earl H.	Woodland, Cal.	Radiology
38. Grinnan, Andrew G.	New York, N. Y.	Diagnostic Roentgenology
39. Hagelshaw, Gayland L.	Bay City, Mich.	Roentgenology
40. Hankins, Franklyn D.	Riverside, Cal.	Therapeutic Radiology
41. Harrington, Elmer J.	Holyoke, Mass.	Diagnostic Roentgenology
42. Hartgraves, Thomas A.	Phoenix, Ariz.	Radiology

43. Harvey, Joseph L. Waterbury, Conn. Radiology
44. Henderson, Orville L. New York, N. Y. Radiology
45. Henle, Carye-Belle. Newark, N. J. Radiology
46. Hirsch, Henry. New York, N. Y. Roentgenology
47. Horvath, Rudolph J. New York, N. Y. Diagnostic Roentgenology
48. Ingersoll, Charles F. Grand Rapids, Mich. Radiology
49. Inlow, Herbert H. Shelbyville, Ind. Radiology
50. Irvine, Archie D. Edmonton, Alberta. Radiology
51. Jackson, Howard L. Springfield, Mass. Diagnostic Roentgenology
52. Jellen, Joseph. Los Angeles, Cal. Radiology
53. Jellinger, David L. New York, N. Y. Radiology
54. Kalayjian, Bernard S. Charleston, S. C. Radiology
55. Karshner, Rolla G. Los Angeles, Cal. Roentgenology
56. Kile, Robert F. San Francisco, Cal. Radiology
57. Klein, Isadore. New York, N. Y. Diagnostic Roentgenology
58. Knox, Lawrence M. Carmel, Cal. Roentgenology
59. Koenig, Carl F. Philadelphia, Pa. Radiology
60. Laing, Donald R. Pasadena, Cal. Radiology
61. Lattomus, Winfield W. Wilmington, Del. Diagnostic Roentgenology
62. Lavine, Morris J. Syracuse, N. Y. Diagnostic Roentgenology
63. Leclercq, George T. Minneapolis, Minn. Roentgenology
64. Lefrak, Louis. New York, N. Y. Diagnostic Roentgenology
65. Leibert, Harry F. Bethlehem, Pa. Radiology
66. Levene, George. Boston, Mass. Radiology
67. Levi, Leo M. Pasadena, Cal. Therapeutic Radiology
68. Levinson, Louis J. Newark, N. J. Therapeutic Radiology
69. Lipscomb, Thomas H. Jacksonville, Fla. Roentgenology
70. Lofstrom, James E. Detroit, Mich. Radiology
71. Lutze, Frederick H. Brooklyn, N. Y. Radiology
72. MacRae, J. Donald. Asheville, N. C. Roentgenology
73. McCarty, E. D. Seattle, Wash. Radiology
74. McNeill, Clyde. Louisville, Ky. Roentgenology
75. Macdonald, Ian G. Cornwall, N. Y. Therapeutic Radiology
76. McAvin, James S. Omaha, Nebr. Radiology
77. Madden, John E. Philipsburg, Pa. Roentgenology
78. Marshall, William A. Chicago, Ill. Radiology
79. Martin, James L. Washington, D. C. Radiology
80. Maurer, John F. Somerset, Pa. Roentgenology
81. Mayoral, Antonio. New Orleans, La. Diagnostic Roentgenology
82. Meister, Edward J. Denver, Colo. Radiology
83. Meltsner, Louis. Hoboken, N. J. Diagnostic Roentgenology
84. Mengel, Charles L. Allentown, Pa. Therapeutic Radiology
85. Merrill, Adelbert S. Manchester, N. H. Roentgenology
86. Milholland, William G. Fresno, Cal. Radiology
87. Moore, Frank T. Akron, O. Radiology
88. Muller, Frederick W. San Diego, Cal. Roentgenology
89. Murphy, Walter T. Buffalo, N. Y. Radiology
90. Noll, Joseph E. Port Jervis, N. Y. Diagnostic Roentgenology
91. O'Donoghue, James. St. Joseph, Mo. Radiology
92. Okrainetz, Clara L. New York, N. Y. Radiology
93. Olpp, John L. Englewood, N. J. Radiology
94. Parrish, Madison E. Sumter, S. C. Radiology
95. Peterson, Harold O. Minneapolis, Minn. Radiology
96. Pitts, Thomas A. Columbia, S. C. Radiology
97. Pohle, Ernst A. Madison, Wis. Radiology
98. Pomeroy, Lawrence A. Cleveland, O. Therapeutic Radiology
99. Ponemon, Irving W. Jamaica, L. I., N. Y. Roentgenology
100. Quimby, Will A. Wheeling, West Va. Radiology
101. Rayle, Albert A. Atlanta, Ga. Roentgenology
102. Rich, James S. Evansville, Ind. Roentgenology
103. Robinson, J. Maurice. San Francisco, Cal. Radiology
104. Root, Joseph C. Cleveland, O. Diagnostic Roentgenology
105. Runkle, William A. Memphis, Tenn. Diagnostic Roentgenology
106. Sammet, Joel F. Hines, Ill. Radiology
107. Sampson, David A. Philadelphia, Pa. Radiology
108. Schechter, Samuel. New York, N. Y. Diagnostic Roentgenology
109. Schenk, Max. New York, N. Y. Radiology
110. Schmidt, William H. Philadelphia, Pa. Radiology
111. Schraer, Paul H. Philadelphia, Pa. Radiology
112. Schumacher, Arthur H. Cleveland, O. Roentgenology
113. Shumaker, Paul R. Oakland, Cal. Roentgenology
114. Simonds, Francis L. Omaha, Nebr. Radiology
115. Smith, Charles D. Richmond, Va. Radiology
116. Smith, Ivan H. London, Ont. Therapeutic Radiology
117. Stark, Jesse D. New York, N. Y. Diagnostic Roentgenology
118. Stein, Joseph. Hawthorne, N. Y. Diagnostic Roentgenology

119. Stein, Justin J.
120. Steinbach, Meyer
121. Sterling, Harold W.
122. Stevenson, Clyde A.
123. Stilson, Walter L.
124. Taormina, Louis J.
125. Teahan, Roscoe W.
126. Tenzel, William V.
127. Thorpe, Moreton J.
128. Turner, John W.
129. Van Strander, William H.
130. Vaughan, Walter W.
131. Wagner, John G.
132. Wall, Willard W.
133. Ware, James G.
134. Warmolts, Irving J.
135. Westing, Siegfried
136. Whitmore, William H.
137. Williams, Francis
138. Wyser, Doreen D.

Hines, Ill.
Philadelphia, Pa.
Lyons, N. J.
Temple, Tex.
Los Angeles, Cal.
Brooklyn, N. Y.
Philadelphia, Pa.
New York, N. Y.
Reno, Nev.
Wrentham, Mass.
Hartford, Conn.
Durham, N. C.
Riverside, N. J.
Minot, N. D.
Bakersfield, Cal.
Newport, R. I.
Brooklyn, N. Y.
Norfolk, Va.
San Francisco, Cal.
Ossining, N. Y.

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Address all communications to B. R. Kirklin, M.D., *Secretary American Board of Radiology*, Mayo Clinic, Rochester, Minn.

ANTI-CANCER WEEK IN FRANCE

Anti-cancer Week (La Semaine Internationale contre le Cancer) is to be celebrated this year in France from November 23 to 30, under the sponsorship of the International Union against Cancer, of which Sénateur Justin Godart is President, and with the co-operation of the French Government.

One of the special features of this Anti-cancer Week is an international celebration to commemorate the discoveries of x-rays and radium, as well as the extraordinary developments in physics which followed the discovery of the electron and Hertzian waves. Instructive and interesting scientific sessions will be held at the Palais de la Découverte in Paris. The program is to be divided into four principal sections, as follows:

1. Physics of the Electron;
2. Physics and Biological Action of X-rays;
3. Physical and Biological Studies on Radio-activity;
4. Physical and Biological Studies on the Hertzian or Short Waves.

The famous physicist and Nobel Laureate, Professor Jean Perrin, will preside at these sessions and eminent authorities from all parts of the world will participate.

The entire celebration will be one of the finest public tributes ever rendered to those great pioneers whose discoveries have been of inestimable value to the human race.



Medal commemorating the discovery of radium by Pierre and Marie Curie, made for the International Union against Cancer.

A medal has been made especially for the occasion and information concerning it and the program may be obtained from the General Secretary, Mr. L. W. Tomarkin, 18 rue Soufflot, Paris.

MID-WESTERN RADIOLOGISTS

The Mid-western Radiologists will convene for a clinical conference in Detroit on February 10 and 11, 1939. The meeting place is the Book-Cadillac Hotel.

The program usually presented at these meetings consists chiefly of subjects of clinical

importance with roentgenological features. All of the details of the program have not yet been arranged, naturally, but a preliminary program will be announced in the near future.

Information may be obtained from E. R. Witwer, M.D., Harper Hospital, Detroit, General Chairman.

COMMUNICATION

TEXAS RADIOLOGICAL SOCIETY

This Society reports a splendid meeting at San Antonio, on October 22, with 38 members present. The program was as follows:

R. G. Giles, M.D., President's Address, Roentgen Therapy in Essential Hypertension. Discussed by Lt. Col. Albert Bowen, M.D., San Antonio; J. B. Johnson, M.D., Galveston; C. L. Martin, M.D., Dallas; C. A. Stevenson, M.D., Temple; J. R. Smith, M.D., San Angelo.

C. A. Stevenson, M.D., Roentgen Therapy in Carotid Sinus Syndrome. Discussed by J. B. Johnson, M.D., and Henry C. Harrell, M.D., Texarkana.

Tom Bond, M.D., Ft. Worth, X-ray Treatment of Pneumonia. Discussed by James Wilson, M.D., Lubbock; C. H. Crockett, M.D., San Antonio; C. L. Martin, M.D.; Lt. Col. Albert Bowen, M.D.; E. V. Powell, M.D., Temple; J. R. Smith, M.D., and J. J. Faust, M.D., Tyler.

C. L. Martin, M.D., and J. R. Maxfield, M.D., Waco, X-ray Treatment of Sinusitis. Discussed by C. F. Crain, M.D., Corpus Christi; E. V. Powell, M.D.; C. A. Wilcox, M.D., Wichita Falls; C. A. Stevenson, M.D., and Davis Spangler, M.D., Dallas.

Mr. Mac F. Cahal, representing the Inter-Society Committee for Radiology, spoke on "Economic Problems in Radiology," after which a general discussion ensued.

E. V. Powell, M.D., Irradiation of Epiphyses to Prevent Growth of Bone. There was no discussion of this paper, which was presented during the afternoon session, because an excursion had been planned, at the invitation of Lt. Col. Albert Bowen, M.D., to the X-ray Department of the Base Hospital, Ft. Sam Houston.

BOOKS RECEIVED

Books received are acknowledged under this heading, and such notice may be regarded as an acknowledgment of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

RÖNTGENDIAGNOSTIK DER KNOCHEN- UND GELENK-KRANKHEITEN (Roentgen Diagnosis of Diseases of the Bones and Joints). By Prof. Dr. ROBERT KIENBÖCK, Vienna. Vol. 5 (Section on Joint Diseases, pages 451-1049), Rheumatoid Joint Tuberculosis. With 610 illustrations in the text. Published by Urban & Schwarzenberg, Berlin, 1938. Price: R.M. 60.00.

THE MEDICAL APPLICATIONS OF THE SHORT WAVE CURRENT. By WILLIAM BIERMAN, M.D., Attending Physical Therapist, Mount Sinai Hospital, New York City; Assistant Clinical Professor of Therapeutics, New York University College of Medicine. Includes a Discussion of its Physical and Technical Aspects, by MYRON M. SCHWARZCHILD, M.A., Physicist, Beth Israel Hospital, New York City, Instructor of Physics in Radiology, New York University College of Medicine. A volume of 379 pages, with 23 plates. Published by William Wood & Company, Baltimore, 1938. Price: \$5.00.

THE 1938 YEAR BOOK OF RADIOLOGY. *Diagnosis* edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Associate Editor, WHITMER B. FIROR, M.D., Assistant in Roentgenology, Johns Hopkins University; Assistant in Roentgenology, Johns Hopkins Hospital. *Therapeutics* edited by IRA I. KAPLAN, B.Sc., M.D., Director, Division of Cancer, Department of Hospitals, City of New York; Clinical Professor of Surgery, New York University Medical School; Director, Radiation Therapy Department, Bellevue Hospital, New York City; Director, New York City and Brooklyn Cancer Institutes; Associate Radiologist, Lennox Hill Hospital, New York City. A volume of 512 pages, with 511 illustrations. Published by The Year Book Publishers, Inc., Chicago, 1938. Price: \$4.50.

1938 RENEWAL PAGES FOR "DIAGNOSTIC ROENTGENOLOGY." Edited by ROSS GOLDEN, M.D. Contains 282 pages, including front matter and index. Available only to purchasers of original loose-leaf edition. Published by Thomas A. Nelson & Sons, New York City, 1938. Price of 1938 Renewal Pages, \$4.50.

BOOK REVIEW

DER KREUZSCHMERZ IN SEINER BEZIEHUNG ZUR WIRBELSÄULE (Low Back Pain in its Relation to the Vertebrae). By Priv. Doz.

Dr. J. E. W. BROCHER, Geneva. A volume of 89 pages, with 101 illustrations. Published by Georg Thieme, Leipzig, 1938. Price: R.M. 19.50.

The author has attempted in a well arranged monograph to present in brief form each of the factors which may be the cause of low back pain. Each of the possible causative factors is presented concisely and well, and, of these conditions, all that are commonly recognized to-day as causative factors in backache are presented.

Of the causative factors in lumbosacral backache a more elaborate discussion is given. The pathological, anatomical background for this is laid by Prof. Dr. M. Askanazy of the pathological institute of Geneva. The author goes on with a theoretical discussion of the causes of lumbago and sciatica, testing con-

ditions recognized as causes of the condition. This follows a discussion on the differential diagnosis which the author divides into three parts, from the standpoint of internal medicine, from the standpoint of surgery, and from the standpoint of gynecology. Under the differential diagnosis from the standpoint of surgery, mention is made of the prolapsed disk as a cause of pain.

A section of illustrative roentgenograms follows: these are beautifully reproduced and present most of the common lesions. Following this, a section of anatomical-pathological cuts is given, all of which are well selected and demonstrate well the points to be illustrated. The volume is beautifully printed and the illustrations are clear, as is usually found in this series of monographs. It is a volume well worth while to anyone interested in orthopedic surgery.

ABSTRACTS OF CURRENT LITERATURE

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THE FOLLOWING ABTRACTORS HAVE CONTRIBUTED TO THIS ISSUE

S. RICHARD BEATTY, M.D., of Denver, Colo.	E. T. LEDDY, M.D., of Rochester, Minn.
W. R. BROOKSHER, M.D., of Fort Smith, Ark.	J. B. McANENY, M.D., of Madison, Wis.
BENJAMIN COPLEMAN, M.D., of Perth Amboy, N. J.	ANTONIO MAYORAL, M.D., of New Orleans, La.
IRVING I. COWAN, M.D., of Milwaukee, Wis.	JOHN G. MENVILLE, M.D., of New Orleans, La.
JOSEPH T. DANZER, M.D., of Oil City, Penna.	LESTER W. PAUL, M.D., of Madison, Wis.
PERCY J. DELANO, M.D., of Chicago, Ill.	ERNST A. POHLE, M.D., Ph.D., of Madison, Wis.
WILLIAM H. GILLENLINE, M.D., of New Orleans, La.	ERNST A. SCHMIDT, M.D., of Denver, Colo.
HANS W. HEFKE, M.D., of Milwaukee, Wis.	W. A. SODEMAN, M.D., of New Orleans, La.
LEWIS G. JACOBS, M.D., of Winona, Minn.	CHARLES G. SUTHERLAND, M.D., of Rochester, Minn.

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ANEURYSM

Rasmussen Aneurysm: Its Roentgen Appearance. Report of Case, with Necropsy. Barnet P. Stivelman and Milton Malev. *Jour. Am. Med. Assn.*, **110**, 1829-1831, May 28, 1938.

In 1868 Rasmussen reported a series of aneurysms of branches of the pulmonary artery in tuberculous cavities. These have long been recognized among the more common causes of massive and fatal hemoptysis in phthisis. Fearn described such an aneurysm about 100 years ago. Postmortem examination revealed numerous cavities in both lungs. "In the upper left lobe there was an evacuated cavity, two inches in diameter and into it was seen jutting distinctly an aneurysmal sac as large as a nutmeg, which had burst by a cleftlike opening. The parieties of the sac were thin, and it did not contain any fibrinous layers. A vessel the size of a small crow-quill, leading from a considerable trunk of the pulmonary artery, was distinctly traceable into the sac." The aneurysms result from the absence of support on one side of the vessel following the destruction of the adjacent lung tissue. The tendency of the vessel to expand toward the unsupported side was materially hastened by the increased intra-arterial pressure as a consequence of the destruction of the neighboring blood vessels by the tuberculous process.

A case is reported in which the aneurysm was clearly visible on the roentgenogram of the chest.

CHARLES G. SUTHERLAND, M.D.

ANIMAL EXPERIMENTATION

The Behavior of the Reticulocytes of the White Mouse Following Roentgen Irradiation. H. Langendorff. *Strahlentherapie*, 1938, **62**, 304.

In this third communication of a series of articles on the same subject, the author compared the effect of single doses and protracted fractional doses. The intensity was 0.5-8 r/min. for the single dose and 1 r/min. for the second method. The total doses applied varied from 100 to 1,000 r. It appeared that the effect of the fractional method without protraction was much more pronounced, both on the reticulocytes as well as on the organism as a whole than for the protracted fractional dose. The reaction following "long time" irradiation took a longer course in most instances than for the other method; likewise the same total dose was tolerated better with the protracted fractional dose than with simple fractionation.

ERNST A. POHLE, M.D., Ph.D.

APPARATUS

Importance of Rapid Exposures in the Roentgen Physiologic Study of the First Stages of Deglutition. P. Huet and Nemours-Auguste. *Bull. et Mém. Soc. de Radiol. Méd. de France*, **26**, 148-150, March, 1938.

In their study of deglutition, the authors find that rapid exposures, of less than $1/100$ second, are necessary.

Such exposure times are obtained by the use of the Synchro-contactor of the Compagnie Generale de Radiologie, using 140 kv. with 50 ma. Excellent profile roentgenographs are obtained on fine-grained screens by this technic.

S. R. BEATTY, M.D.

Dispersion of Short Waves in the Neighborhood of the Emitting Apparatus. André Denier. *Bull. et mém. Soc. de Radiol. Méd. de France*, **8**, 119, 120, February, 1938.

The author gives the results of his studies of the dispersion of short wave currents in the neighborhood of the apparatus. Metallic mesh screening is insufficient; a solid screen absorbs all of the radiation. The concentration of energy is greatest near the walls of the room. The approach of a piece of metal or of an individual to the recording apparatus or near to the short wave apparatus while a patient is being treated, results in a diminution of the energy. A metallic screen about the patient may offset the absorbing effect of nearby walls.

S. R. BEATTY, M.D.

The Technic of Rapid Radiographic Development. Lars Lönnerblad. *Acta Radiol.*, **19**, 73-84, March, 1938.

The author describes a developer which contains pyroocatechin and caustic alkali as its chief ingredients. Due to rapid oxidation when exposed to air, development must take place in a tank with small surface and tight cover. The process must be watched continuously; for this purpose the tank walls are made of transparent glass. By this method, full development of a roentgenogram was possible within from 30 to 40 seconds.

ERNST A. SCHMIDT, M.D.

A Simple Portable Apparatus for Galvanization. T. Nogier. *Bull. et mém. Soc. de Radiol. Méd. de France*, **8**, 114-116, February, 1938.

Using two to six dry batteries of 4.5 volts and three rheostats of 10,000 ohms each, the author has devised a source of direct current for galvanization free of line variations and of the inconveniences of wet cells. With two cells, up to 9 ma. with 1,000 ohms, and with six cells, up to 20 ma. are available.

S. R. BEATTY, M.D.

Theory and Practice of Direct Radiocinematography. Van de Maele. *Bruxelles-méd.*, **18**, 101-106, Nov. 28, 1937.

The author discusses the advantages and disadvantages of the indirect and direct methods of roentgen cinematography. He has constructed an apparatus for direct cinematography which is briefly discussed. With

it, he has been able to secure films of the abdominal organs which he does not believe can be successfully registered by the indirect method.

S. R. BEATTY, M.D.

ARTHRITIS

The Place of X-rays in the Treatment of Certain Forms of Chronic Arthritis. F. Hernaman-Johnson. *British Jour. Radiol.*, 10, 765-780, November, 1937.

The author summarizes as follows: "The local application of x-rays is of great value in cases of hypertrophic, non-infective osteo-arthritis; worth trying in chronic infective arthritis, and may give local and temporary relief in rheumatoid conditions. It is valueless in true degenerative arthritis in the very old.

"The constitutional use of x-rays is of pronounced value in checking the otherwise inevitable advance of spinal arthritis in young people, and its possibilities in the treatment of rheumatoid arthritis are worth investigating."

AUTHOR.

The Arthritic Syndrome, Radiodiagnosis, and Indications for Physiotherapy. P. Robert. *Bull. et mém. Soc. de Radiol. Méd. de France*, 8, 109, 110, February, 1938.

A brief discussion of the arthritic syndrome. The author favors ionization with potassium iodide in the more accessible joints, roentgen therapy to the spine and hips.

S. R. BEATTY, M.D.

CANCER (DIAGNOSIS)

Epithelioma of the Mouth in Hottentot Women. J. Helman. *South African Med. Jour.*, 12, 17, 18, Jan. 8, 1938.

The author describes a relatively frequent type of epithelioma of the lips and buccal mucous membrane encountered in Hottentot women who smoke a certain metal pipe made of tin, iron, or brass, and shaped like a straight cigarette-holder. After a few puffs this pipe gets very hot. Leukoplakia as a precancerous condition is frequently observed. The condition was never observed in male Hottentots, who use the ordinary wood pipe, either home-made or of European manufacture.

ERNST A. SCHMIDT, M.D.

Modern Trends in the Treatment of Cancer of the Rectum and Rectosigmoid. Fred W. Rankin. *Jour. Am. Med. Assn.*, 109, 1719-1723, Nov. 20, 1937.

In the hands of men of mature experience the widest extirpation is bound to be the choice of the radical surgical procedures. Age, co-existing debilitating diseases, and general undermining of the physical equilib-

rium demand even a wider selection of methods than is ordinarily essential in the surgical treatment of malignant growths.

The acceptance of group management with pre-operative hospitalization during the rehabilitation and decompression by medical or surgical measures is now almost universal and has proved its worth beyond any peradventure.

The diagnosis of cancer of the rectum and rectosigmoid can be made in 100 per cent of the cases, provided a careful digital examination or proctoscopic examination, or both, is made as a matter of routine. Biopsy may be done regularly or in cases in which there is a question of the pathologic diagnosis.

There are, unfortunately, no early pathognomonic symptoms. Perhaps irregularity of the bowel habit as characterized by diarrhea, or constipation, or alternating periods of the two over a short time, e.g., a month or six weeks, is the most characteristic symptom.

A growth anywhere within 25 cm. of the anal margin can always be diagnosed by proctoscopy, and direct visual examination is preferable to radiography. However, if the result of proctoscopic examination is negative, x-ray investigation is urgently indicated.

A knowledge of the type of pathologic process is important from the standpoint of both prognosis and treatment. While it is uniformly felt that the higher grade tumors are radiosensitive and less amenable to surgical treatment, it is definitely known that there are many exceptions to this rule. In order to grade the tumor, rather than as a diagnostic measure, biopsy has been made regularly on all rectal and rectosigmoidal cancers for twelve years. Any tendency to scatter cancer cells by this biopsy has not been observed in the author's experience.

It is frequently advantageous to test the radiosensitivity by an actual application. Perhaps the future will reveal radium alone or in combination with surgical treatment to have its most advantageous use in high grade growths in the young. The colloidal group of cancers, while notoriously prone to recur after surgical removal, are fairly well established as radiosensitive tumors. Unquestionably, accumulated data show conclusively that in certain cases cancer of the rectum can be cured by radium and that the number of these cases is slowly increasing. Epitheliomas of the anal canal are better treated by radium than by surgical procedures, but as one advances toward the rectosigmoid, the latter becomes the treatment of choice.

The greatest value of radium is as a palliative procedure for inoperable and recurring lesions. With its use bleeding is frequently controlled, the tumor frequently recedes enormously, and occasionally so-called inoperable tumors are rendered removable.

Pre-operative use of radium is still a most uncertain agent and more data are necessary relative to its action before it is accepted as a routine.

Careful scrutiny of series of cases in which surgical diathermy was used emphasizes not only that colostomy was necessary in one-half of the cases, but that the mortality figures approached those for patients present-

ing the less formidable variety of surgical risks who are treated by resection. The method requires special apparatus and certainly extreme care in its application.

CHARLES G. SUTHERLAND, M.D.

A New Case of Early Gastric Cancer Invisible Macroscopically. A. Gosset, René A. Gutmann, Ivan Bertrand, and Garcia Calderon. *Bull. et Mém. Soc. de Radiol. Méd. de France*, **26**, 144, 145, March, 1938.

The authors present another case of carcinoma of the stomach demonstrable roentgenologically, but not apparent to palpation or inspection at operation.

Roentgenologically the lesion was small and of the "niche en plateau" type.

S. R. BEATTY, M.D.

CANCER (THERAPY)

Short Distance Irradiation of Skin Carcinoma. Julius Wendlberger. *München. med. Wchnschr.*, **85**, 478, March 31, 1938.

The author, while considering radium needles the most desirable treatment for skin cancer, for various reasons used Bode's modification of Chaoul's technic in the treatment of these lesions.

He used a F.S.D. of 7 cm., 55 kv., 4 ma., 227 r/m. The H.L.V. in Al was 1 mm., in Cu, 0.04 mm. He gave 500 r per treatment, treating daily for six days, then giving four days' rest, then daily treatments for four days, then 12 days' rest, then daily treatments for three days. The total dose thus given was 6,500 r in 29 days. He places emphasis on the fractionation, the small field size (10-15 sq. cm. or, at the most, 25 sq. cm.), the short focus-skin distance, and the long wave length radiation, most of which is absorbed in the tumor.

In 15 cases, 90 per cent primary healing occurred, and 11 (73 per cent) were completely cured. Five other cases were not included because they later left the writer's care.

L. G. JACOBS, M.D.

Effect of Radiation Therapy on Metastatic Carcinoma of Bone. Frank E. Butler and Ivan M. Woolley. *Northwest Med.*, **37**, 84, March, 1938.

The value of radiation therapy in certain types of malignancy is recognized, but its result uncertain. However, many favorable and some striking results justify its trial in spite of some unfavorable experiences.

No prediction can be made, based on the morphologic classification of tumors, as quite often, in actual practice, tumors that one would expect to be radiosensitive are not so, and *vice versa*.

The authors are convinced that deep-seated malignancy cannot be stopped by one course of roentgen therapy, but find that those patients showing favorable response can be made comfortable, and the disease kept in check for a number of years.

Because of time limit the discussion will be confined to irradiation therapy of metastatic bone tumors.

Primary bone tumors do not respond as well to irradiation.

While carcinoma of the prostate metastasizes to bone much more frequently than does carcinoma of the breast, this latter type of tumor occurs so much more frequently that, in the experience of the writers, it constitutes the bulk of the metastatic bone tumors.

Given in order, the following are the bones most frequently involved: pelvic bones; upper ends of the femora; the spine, the lumbar and cervical more often than the dorsal vertebrae. The physician should bear in mind that quite often persistent nerve pain is the only symptom of which complaint is made. Malignancy, like osteomyelitis, may attack bones long before it can be detected, and very often a pathologic fracture occurs before metastasis is discovered. For this reason when a cancer patient complains of well established nerve pain, it is the practice of the writers to irradiate the bone in the area of the nerve root.

A. MAYORAL, M.D.

Irradiation in the Treatment of Carcinoma of the Uterus, with Special Reference to Corpus Carcinoma. Louis E. Phaneuf. *Am. Jour. Roentgenol. and Rad. Ther.*, **39**, 855-860, June, 1938.

In the past 20 years irradiation with radium and roentgen rays has supplanted surgery in the treatment of cervical cancer. This is in contrast to the management of cancer of the uterine body, wherein surgery is still indicated. The surgical method of treatment has given five-year arrests in 60 to 70 per cent of the cases. Irradiation in corpus carcinoma is reserved for patients advanced in years, having definite contra-indications to operation. The author gives as a preliminary report the results of irradiation in 20 cases of carcinoma of the uterine body. He reports 25 per cent of the cases as five-year survivals.

IRVING I. COWAN, M.D.

The Survival of a Case of Malignant Granuloma. P. Ponthus and Quisefit. *Bull. et mém. Soc. de Radiol. Méd. de France*, **8**, 121-123, February, 1938.

A case of malignant granuloma surviving seven years after the first roentgen treatment is reported. Treatments had been local in type and had kept the patient comfortable and in good health until the onset of the terminal stages.

S. R. BEATTY, M.D.

The Treatment of Metastatic Carcinoma of the Cervical Lymph Glands. I. Jovin. *Strahlentherapie*, 1938, **62**, 262.

The author discusses in detail the management of patients with metastatic cervical glands. He divides his material into three groups: (1) Those with palpable glands or suspicious glands; (2) those with metastases on one side of the neck, and operable; (3) those with either inoperable or operable glands but with bilateral involvement. The treatment for all groups is either surgical or radiological. If operable, radical resection

is advocated, otherwise x-ray or radium therapy. Technic for roentgen rays: two fields on each side of the neck which include the submental and submaxillary area as well as the parotid and supraclavicular regions. Total dose is 2,000 r applied according to Coutard's technic. Prophylactic treatment in patients without palpable glands can be given in smaller doses. The author uses about 1,000-1,500 r per field and treats all four areas over a period of 30 days.

Radium therapy can be given by means of seeds, needles, and small screens implanted into the tumors. However, external radium therapy seems to be the method of preference. If large amounts of radium are available, telecurietherapy is indicated; otherwise, special molds have to be prepared holding anywhere from 100 to 300 mg. radium and applied at a distance of from 3 to 8 cm. from the skin. The treatment takes approximately from 8 to 12 days, with daily exposures of from 8 to 16 hours. For a distance of 3 cm., the total dose is 400 mg.-hr. per sq. cm. of surface.

The author recommends prophylactic irradiation in all patients because, even in the absence of definitely palpable glands, there may be microscopic metastases. In Group 2, irradiation may be considered before resection. In patients with poor general condition, radiation therapy should be given preference. All patients must receive post-operative irradiation. Radium or x-ray therapy is the method of choice for Group 3.

ERNST A. POHLE, M.D., Ph.D.

The Effect of Near Distance Roentgen Irradiation on the Malignancy of Cancer Tissue. A. E. Roffo. *Strahlentherapie*, 1938, **62**, 363.

The author studied the effect of near distance roentgen rays on implanted carcinoma and sarcoma in rats. Potentials of 54 and 60 kv. were used, with the doses varying from 68 to 2,660 r. Irradiation of tumor specimens *in vitro* before implantation, according to this method, decreased the malignancy of the neoplasms. The effect was more pronounced the higher the potential and the longer the duration of the exposure. The carcinoma was affected more by irradiation than the sarcoma.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy in Primary Lung Carcinoma. Armando Cabrera. *Medicina de Hoy*, **3**, 7-12, January, 1938.

Four cases of primary carcinoma of the lung treated by short wave roentgen therapy, in which the patients were restored to health, are reported. The writer knows these to be exceptional cases and admits many failures. He trusts that the results will be permanent and not transitory. Coutard's technic was followed in giving the treatments.

A short abstract of each case follows.

Case A, a Cuban farmer 55 years of age. The tumor was located in the base of the right lung, with metastasis to the right humerus. The chest was treated

through four ports of entry, each receiving 2,500 r. The total dosage was given in 15 consecutive days. Additional doses were given to the arm.

Case B, a Cuban chauffeur 54 years of age. The tumor was located in the right hilum, causing atelectasis of the upper lobe. This patient received 9,000 r through three ports of entry.

Case C, a Cuban farmer 68 years of age. The tumor was located in the left upper lobe. The patient received 13,000 r through five ports of entry, in 40 treatments, over a period of seven weeks.

Case D, a Spanish merchant 64 years of age. The tumor was located in the right upper lobe. The patient received 11,000 r. Number of ports of entry not given.

The writer makes a plea to the general practice to submit early cases to roentgen therapy.

A. MAYORAL, M.D.

Correlation of Calculated Tumor Doses and Five-year Survivals in Radiation Therapy of Cancer of the Cervix: A Review of 136 Cases. E. L. Frazell. *Am. Jour. Roentgenol. and Rad. Ther.*, **39**, 861-865, June, 1938.

The author reviewed primary carcinoma of the cervix. Minimum doses of radiation were calculated in terms of threshold erythemas. Seventy per cent of the cases were either advanced or very advanced as to extent of the disease in the pelvis and in these cases the calculated dose was generally low and the survival rate correspondingly poor. The author concludes that any method of radiation therapy delivering less than six erythemas to the parametrium will fail to control the disease in the majority of the cases.

IRVING I. COWAN, M.D.

THE COCCYX

Coccygodynia and Pain in the Superior Gluteal Region and Down the Back of the Thigh: Causation by Tonic Spasm of the Levator Ani, Coccygeus and Piriformis Muscles and Relief by Massage of These Muscles. George H. Thiele. *Jour. Am. Med. Assn.*, **109**, 1271-1274, Oct. 16, 1937.

When the coccyx or the coccygeal joints are injured or when the surrounding tissues are the seat of inflammation, any contraction of the muscles attached to the coccyx will excite the characteristic pain of coccygodynia. Observation has confirmed the presence of tonic spasm of the levator ani and coccygeus muscles. A large percentage of patients with coccygodynia complain also of pain in the supragluteal region and/or down the back of the thigh; tenderness and tonic spasm of the piriformis muscle is also found almost without exception.

Some of the patients stated that their pain first began as a sense of weight or heaviness which they at first referred to the rectum. This sensation gradually became more severe, and the complaint was that of severe aching and cramping pain referred to the region of the coccyx, more noticeable when sitting in a hard chair, or

during the acts of arising and sitting down. Inability to lie comfortably on the back was a frequent complaint, the pain being worse in that position. Periodic attacks of lancinating severe coccygeal pain superimposed on the aching pain were frequent.

Massage of the pelvic muscles involved by a definite technic will definitely relieve the symptoms in the great majority of cases.

CHARLES G. SUTHERLAND, M.D.

DIABETES

Inoperable Carcinoma of the Ovary in a Diabetic Patient Cured by Roentgen Rays. F. Gál. *Strahlentherapie*, 62, 516, 1938.

The author has seen several cases of advanced carcinoma of the uterus in patients who suffered at the same time from diabetes. He noticed that they responded remarkably well to moderate doses of roentgen rays. He relates briefly in this article the history of a woman 32 years of age with a carcinoma of the ovary, operated on in June, 1928. Only partial removal of the tumor could be carried out. Two weeks after the operation she received through two sacral and two abdominal areas 500 r per field at 180 kv., 0.5 Cu + 3 mm. Al. Further series were given several times at intervals of from six to eight weeks. The patient has been re-examined regularly and now, six years after the operation, she is in good general condition and there is no evidence of tumor. It is concluded that apparently carcinoma of the diabetic reacts more favorably to irradiation than of those with normal sugar metabolism.

ERNST A. POHLE, M.D., Ph.D.

THE DIAPHRAGM

Roentgenologic Diagnosis of Various Juxta-diaphragmatic Lesions, Particularly Perinephric Abscess. Ralph D. Bacon. *Pennsylvania Med. Jour.*, 41, 992-1000, August, 1938.

Various types of herniations of the diaphragm, both congenital and acquired, are described briefly by the author, and are illustrated by typical cases.

Extrinsic lesions affecting the diaphragm are described in greater detail. The author states that a partially-obstructing foreign body in a bronchus will cause a depression and partial fixation of the diaphragm on the affected side, and that when the obstruction is complete the hemidiaphragm is elevated and does not move. Lower lobe pleurisy, diaphragmatic pleurisy, and lower lobe pneumonia may elevate and restrict the movement of the diaphragm but it is not affected in bronchopneumonia or other bronchogenic lesions.

Pneumoperitoneum is found in 85 per cent of all patients with a perforated ulcer who have had a relatively long ulcer history. This does not appear to be a good diagnostic sign when the ulcer symptoms are of less than two months' duration. The most frequent cause of immobilization of the diaphragm is peritonitis or a subdiaphragmatic abscess; 25 per cent of the abscesses, according to Delario, contain air.

The author describes his technic which has been used as an aid in the diagnosis of perinephric abscess. After filling the pelvis with contrast media, two exposures are made of the kidney on the same film, one in deep inspiration and one in forced expiration. There will be little or no movement of the kidney pelvis on the affected side.

JOSEPH T. DANZER, M.D.

Error of Diagnosis Due to an Anomalous Right Diaphragm. Guénaux. *Bull. et mém. Soc. de Radiol. Méd. de France*, 25, 783-785, December, 1937.

An anomaly of the diaphragm, not diagnosed, permitted an anomalously situated colon to interpose above the liver, giving the appearance of a consolidation at the base of the right lung-field. A barium enema demonstrated the true state of affairs.

S. R. BEATTY, M.D.

DOSAGE

Experimental Investigations on the Effects of Roentgen Rays on the Suprarenal Glands in Rabbits. Rolf Bull Engelstad and Olav Torgersen. *Acta Radiol.*, 18, 671-687, October, 1937.

According to the authors, the roentgen doses necessary to produce definite changes in the suprarenal glands of rabbits show a decided parallelism with the doses required to produce skin changes.

Doses of 1,000 r or less were followed by practically no changes in either suprarenal glands or skin. After 1,500 r (applied in a single treatment) the changes were mild. Clearly demonstrable skin changes in rabbits require about 1,700 r, but considerably larger doses are necessary to produce an exudative epidermitis. The doses employed by the authors varied from 2,200 r to 2,500 r, administered at one séance. These doses resulted in marked degeneration in the cortex of the suprarenal glands, hyperemia, and occasionally inflammatory infiltration. The degenerative changes were most constant and most prominent in the *zona fasciculata* and the *zona reticularis*. No definite degeneration was demonstrable in the medullary substance. The first reaction observed was an initial hyperemia which appeared within 10 hours after irradiation and receded within from two to three days. The main degenerative reaction was observed, at the earliest, six days after irradiation. It was accompanied by hyperemia and, in some cases, by lymphocytic infiltration. These changes persisted up to six months, the longest period of observation, though they were most pronounced three months after radiation.

The authors emphasize that all conclusions are made difficult by the very great normal variations found histologically in the suprarenal glands of animals (differences in lipid distribution due to varying functional states, exogenic and endogenic complications, etc.). In general, previous observations and investigations of one of the authors (Engelstad) relative to the same subject were confirmed.

ERNST A. SCHMIDT, M.D.

Biologic Determination of the Distribution of Dose and of the Depth Dose Percentage for Normal and Extremely Hard Roentgen Rays. H. Langendorff, L. Graf, and J. Graf. *Strahlentherapie*, **62**, 561, 1938.

Drosophila eggs were placed in canals drilled into a wax phantom and exposed to roentgen rays produced at 180-200 kv. with a half value layer in copper of 0.95-1.5 mm. and also 400 kv. with a half value layer in copper of 6 mm. Graphs are shown in the article giving the depth doses in the central ray obtained by this method. When compared with the results of ionization measurements done by L. and J. Graf, there appears to be satisfactory agreement. As the greatest advantage of the higher potential, the authors consider the quicker drop of the intensity in the first centimeters below the skin. This means that the normal tissue between skin and tumor in the depth receives less irradiation. Whether or not this advantage of 400 kv. x-radiation justifies the higher expense can be decided only after sufficient clinical experience.

ERNST A. POHLE, M.D., Ph.D.

ENDOCRINE GLANDS

The Short Wave Treatment of the Endocrine System: the Diencephalon and the Mesencephalon. Giulio Samuels. *Archivio di Radiologia*, **13**, No. 4, 338-347, 1937.

By means of two instruments, the spectro-reduction meter and the cicloscope, Samuels determines what endocrine organs are in dysfunction and to what extent. Short wave treatment, at times supplemented by endocrine preparations, gives good results, particularly in dysfunction of the pituitary.

E. T. LEDDY, M.D.

THE ESOPHAGUS

Benign Stricture of the Esophagus Complicating Duodenal Ulcer. Edward B. Benedict and Ernest M. Daland. *New England Jour. Med.*, **218**, 599-601, April 7, 1938.

This case report deals with a patient having an esophageal stricture following a posterior Polya type anastomosis for duodenal ulcer. A second operation, an entero-anastomosis, was done 12 days later. A nasal tube was passed several times. About three and one-half months later the patient was readmitted with an esophageal stricture of an inflammatory origin and relieved by bouginage.

It is believed that the stricture was due to an esophagitis but the nasal tube is absolved of any connection with the condition. Roentgenographs are presented demonstrating the stricture and the literature is reviewed.

J. B. McANENY, M.D.

The Irradiation of Esophageal Cancer. Max Lüdin. *Schweiz. med. Wchnschr.*, **68**, 539, 540, May 7, 1938.

Case report of a patient with carcinoma of the upper esophagus (apparently not biopsied) who is alive and clinically cured two years after treatment solely with

x-ray (3,240 r to each of two lateral 8 × 10 cm. fields in 36 treatments, 180 kv., 4 ma., 2 mm. Cu filter, 70 cm. F.S.D., H.W.S. 1.9 mm. Cu).

L. G. JACOBS, M.D.

The Management of Pulsion Esophageal Diverticulum. Frank H. Lahey. *Jour. Am. Med. Assn.*, **109**, 1414-1418, Oct. 30, 1937.

Pulsion diverticula far outnumber all other types. They occur as small, intermediate, and large pouches located, since they are the result of a bulging of esophageal mucosa through a congenital muscular defect at this point, at the esophagopharyngeal level.

Traction diverticula are most commonly situated within the pleura and at, or near, the level of the main pulmonary bronchi, since they are associated with inflammatory processes in the bronchial lymph glands located at this level.

Subdiaphragmatic intrapleural esophageal diverticula probably start as the result of a congenitally weak area in the esophageal wall and develop further into large sacs because of the accumulation of food within the sac and an intrasaccular pressure which is greater than the resistance of the wall of the sac.

A pharyngo-esophageal diverticulum is a protrusion of the mucosa and submucosa of the hypopharynx through the muscular wall of the hypopharynx. The sac lies between the pretracheal and prevertebral fascia, and its neck is surrounded by fibers of the inferior constrictor muscle, and the muscle which splits off from it obliquely to extend down the esophagus, the cricopharyngeus muscle. This muscle's relationship to the sac is of the utmost importance, since unless the constricting muscle fibers about the neck of the sac are accurately removed the sac is quite apt to recur.

The successful operative treatment of esophageal pulsion diverticulum involves the complete removal of the sac and its neck, the complete removal of the constrictor fibers from about the neck of the sac, and the protection of the patient from the development of cellulitis between the prevertebral and pretracheal fascia and extension of this infection into the mediastinum.

The author reviews his series of cases done by the two-stage method, which he prefers, and presents the end-results in 53 cases.

CHARLES G. SUTHERLAND, M.D.

FISTULA

The Radiological Exploration of Some Unusual Fistulous Tracts. Julius Brams. *Illinois Med. Jour.*, **72**, 534-536, December, 1937.

Brams has used radiological exploration of fistulous tracts after the injection of various opaque media and reports three unusual cases—a duodeno-biliary, a reno-cutaneous, and a biliary-cutaneous fistula. He stresses the frequent surprise one encounters in the source, course, and extent of apparently simple fistulous openings when studied in this way. In his experience he gained valuable information in cases of perirectal and peri-urethral tracts, in various abdominal

and fecal fistulae, in fistulous tracts originating from some bone pathology, and in exploring pilonidal cysts. He has never seen any ill effects from this procedure and knows of no contra-indications.

W. A. SODEMAN, M.D.

THE FOOT

Comminuted Fractures of the Os Calcis. H. W. Spiers. *Jour. Am. Med. Assn.*, **110**, 28-31, Jan. 1, 1938.

In the decade prior to 1930 the attitude in general toward this lesion was that such a fracture was unfortunate, that long-continued disability would follow, and that there would be, of course, a high degree of permanent disability. In the average case, if the foot was manipulated and kept immobilized for a rather long period, in the long run a nearly painless though disabled foot was secured. However, it often took from two to four years before this result was obtained. Subastragaloid arthrodesis hastened the process somewhat.

Boehler's method of reduction definitely reduced the length of disability and gave less permanent disability than any other method in the author's experience. On the seventh or eighth day skeletal traction pins are placed through the posterior fragment of the os calcis and through the lower end of the tibia. With the knee in right-angle flexion on a Boehler frame, direct downward screw traction is applied. This is done to correct the upward displacement of the distal fragment, the fragment attached to the Achilles tendon, and to break up the impaction. It places the distal fragment in line with the proximal one and restores the so-called tuber angle. This is the angle of the plane of the subastragaloid joint and the body of the normal os calcis. It varies from 28 to 35 degrees in the normal foot and is partially, or wholly, lost in the average comminuted fracture.

Next, traction at a 45-degree angle to the tibia is applied. This is the angle of traction which makes necessary the pin fixation of the lower end of the tibia. This traction is applied to overcome the overriding of the fragments and thus restore the normal length of the os calcis. Lateral U-clamp compression with metal pressure pads designed to fit the normal lateral curves of the os calcis is then applied. The width of the normal os calcis is estimated, and compression to that width is rapidly applied and quickly released. There has been no circulatory disturbance with necrosis of the tissues as might be expected from this procedure.

Check-up roentgenograms are easily obtained, after which a plaster cast is applied incorporating the skeletal traction. Boehler's non-padded cast has been used regularly. It is split anteriorly before the patient leaves the table.

The Braun frame was used for four weeks post-operatively. Skeletal traction is removed at the end of the fourth week and a plaster boot applied. The patient gets around for about four weeks on crutches. At the end of the eighth or ninth week a calf-lifting walking cast is applied. This allows partial weight-bearing.

Full weight-bearing is not allowed until the fourteenth week. When weight-bearing is begun an accurately fitting arch support is supplied.

CHARLES G. SUTHERLAND, M.D.

Tophi of the Heels. Frederick Christopher and Stanley E. Monroe. *Jour. Am. Med. Assn.*, **110**, 2149, June 25, 1938.

Gout is doubtless more prevalent than is commonly believed, yet the presence of tophi that simulate other lesions is quite rare. While tophi are found in many locations, they have a peculiar affinity for the ears. Tophi of the heels resembling pyogenic lesions are extremely uncommon.

The authors reported a case in which lesions on the heels had been opened five times under the supposition that they were of pyogenic origin.

Smears of the discharge from these lesions showed acicular crystals characteristic of sodium mono-urate. Uric acid studies of the patient's blood showed a high uric acid content. The response to treatment for gout was satisfactory.

CHARLES G. SUTHERLAND, M.D.

March Fracture. Henry W. Meyerdling and George A. Pollock. *Surg., Gynec. and Obst.*, **67**, 234-241, August, 1938.

March foot may be defined as a fracture of the second, third, or fourth—most commonly the second—metatarsal bones without known adequate cause. The most acceptable theory is that the fracture occurs as the result of overloading a foot already weakened functionally and anatomically. In any case of painful feet, a history of over-exercise, or prolonged and excessive weight-bearing, or of wearing of arch supports for weak feet, should, especially, in the absence of direct trauma, cause the physician to think of the condition and have roentgenologic investigation carried out. The symptoms should not be attributed to the more simple tenosynovitis. The roentgen films must be made in multiple projections and carefully studied at varying light angles since a bone, negative roentgenologically at first, has been found several weeks later, on roentgenological examination, or at operation, to be fractured. Differentiation is to be made from tenosynovitis and from osteogenic sarcoma. Swelling, superficial pain, tenderness, and local increase of temperature, with repeatedly negative roentgenograms, should definitely distinguish tenosynovitis. If doubt exists as to sarcoma, biopsy is indicated.

W. R. BROOKSHER, M.D.

FOREIGN BODIES

Localization of Foreign Bodies by Planiscopy. Gunsett and Sichel. *Bull. et mém. Soc. Radiol. Méd. de France*, **26**, 41, 42, January, 1938.

A method of utilizing the planigraph (Bocage) for roentgenoscopic localization of foreign bodies is de-

scribed. A small square of wire is fixed to the screen, superimposed on the shadow of the foreign body. If the foreign body is in the plane of the axis of rotation of the patient, the image will remain in the square, otherwise it will not. The depth can be determined by readjusting the position of the patient until the plane of rotation and that of the foreign body coincide.

S. R. BEATTY, M.D.

A Case of "Silent" Perforation of the Stomach Due to an Unsuspected Foreign Body. Woithelet. *Bull. et Mém. Soc. de Radiol. Méd. de France*, **26**, 150-153, March, 1938.

A case of perforation of the antrum of the stomach by a common pin is reported. The pin was discovered in the roentgenographs of a gastro-intestinal examination and removed at laparotomy. The patient did not recall having ever swallowed the pin but had been having epigastric pain and a sensation of weight for about 12 years, culminating in a bout of severe pain and vomiting, with weight loss of 25 kgr., just previous to the examination.

S. R. BEATTY, M.D.

A Study of the Roentgenologic Localization of Foreign Bodies in the Respiratory and Digestive Tracts. M. Bermond. *Arch. di Radiol.*, **14**, 5-15, January-February, 1938.

Bermond points out that the localization and removal of foreign bodies in the bronchi is generally easy. This remark refers, of course, to opaque foreign bodies. On the other hand, their localization in the abdomen may be very difficult, and is best done by a roentgenologic examination made immediately before operation. Often it is necessary to study the patient in various positions and to fix the position of the foreign body by reference to definite anatomical landmarks.

The paper is illustrated by roentgenograms of foreign bodies in the abdomen and has one colored plate of a drawing made at operation.

E. T. LEDDY, M.D.

THE GALL BLADDER (Normal and Pathologic)

The Improvement of the Roentgenological Gallstone Diagnosis by the Examination of Biliary Sedimentation and Layer Formation. Åke Åkerlund. *Acta Radiol.*, **19**, 23-43, March, 1938.

The author discusses the different films of sedimentation and stratification seen in the dye-filled gall bladder when radiography in erect position supplements the usual plates taken in recumbent position. No other technic than the usual duodenal technic is required (serial films in upright position with dosed compression). The various types of gall-bladder pathology (layer formation of bile, fundal sediment, layer of floating stones) are demonstrated in a series of excellent roentgenograms and diagrams. In addition

to the valuable information furnished in the visualization of cholelithiasis, especially in early and easily overlooked cases, this method gives new viewpoints on the function of normal and pathologic gall bladders, and may aid in the elucidation of the still rather obscure pathogenesis of gallstones. The roentgenological observations are based on the fact that not only concretions with calcium components have a greater specific gravity than bile or cholesterol concretions but also that, during the process of concentration, the contrast bile does not present a uniform degree of concentration. Pure cholesterol stones with a specific gravity equal to, or even lighter than, bile may form a horizontal, suspended, or floating layer of concretions during erect cholecystography.

It must be remembered that these phenomena can be observed only under the artificial conditions existing after administration of contrast medium and not under normal or physiological circumstances. Åkerlund considers the omission of the bile sedimentation and stratification test a definite technical error.

ERNST A. SCHMIDT, M.D.

THE GASTRO INTESTINAL TRACT (DIAGNOSIS)

Essential Periduodenitis. M. E. Gabor. *Wis. Med. Jour.*, **37**, 554-558, July, 1938.

Essential periduodenitis is described as that type of duodenitis due to adhesions of unknown origin. No macroscopic lesions of the gall bladder, duodenum, stomach, or appendix are encountered. The periduodenal adhesions themselves constitute the causative factor and invoke complete stenosis of the duodenum. The pathogenesis of these adhesions is debatable. Some believe them to be of congenital origin while others attribute them to inflammatory causes. The diagnosis is made only with certainty by x-ray examination. The symptoms are not characteristic. Commonly, nausea and headache are present. Vomiting may appear as a later symptom together with some loss in weight. The process is slow and progressive. An important roentgenographic sign is retention or puddling of barium in the duodenum. The duodenal bulb is irregularly shaped—referred to as the shape of a flickering candle flame. The deformity involves a large portion of the duodenum and changes contour almost constantly. Churning movements are observed and in the later stages a high degree of stenosis may be present. The treatment in the earlier stages is medical. When stenosis is present operation is indicated, some type of short circuiting operation such as duodenojejunostomy being the most suitable. One case report is included together with illustrative roentgenograms.

LESTER W. PAUL, M.D.

Two Cases of Megaduodenum. Jens Nordentoft. *Acta Radiol.*, **18**, 722-732, October, 1937.

The author describes two cases of megaduodenum in patients who were operated upon at the State

Hospital of Copenhagen. The first case was that of a two-year-old girl who had been vomiting since birth. The x-ray examination showed the duodenum as large as the stomach. While the stomach emptied within two hours the 72-hour x-ray examination still demonstrated a barium residue in the duodenum. For the relief of the condition a retrocolic duodeno-jejunosomy was performed but the etiology of the duodenal enlargement could not be definitely ascertained even after operation. The second case was that of a 25-year-old farmer whose only complaints were pains in the epigastrium, recurring periodically since childhood. Vomiting, ructus, or regurgitations had never been observed. The roentgen examination showed a normal stomach and an immensely enlarged duodenum with 48-hour barium retention. Neither the x-ray examination nor the subsequent duodeno-jejunosomy gave any definite clues regarding the cause of the affection.

The author discusses the pathologic-etiological aspects of megaduodenum and the usual roentgen phenomena (dilatation, solid barium filling, stenotic peristalsis, antiperistalsis, Kostlivy's "tripartite paradoxal remnant," etc.

ERNST A. SCHMIDT, M.D.

Symptomless Perforations in the Gastro-intestinal Tract. R. Prevot. *Röntgenpraxis*, 10, 303-307, May, 1938.

Acute perforations in the gastro-intestinal tract are usually diagnosed clinically and not roentgenologically. The typical sign for a perforation from a roentgenological aspect is the pneumoperitoneum, visualized in standing position by the demonstration of air under the diaphragms.

Two cases are described in which perforation was proved by roentgen examination without clinical symptoms and without signs of peritoneal irritation.

It must be remembered that air below the diaphragms, that is, a pneumoperitoneum, may be found for some time after an operation, abdominal paracentesis, or tubal insufflation.

HANS W. HEFKE, M.D.

A Case of Diverticulum of the Duodenum. P. Gassmann and E. Grevillot. *Bull. et mém. Soc. Radiol. Méd. de France*, 26, 21, January, 1938.

A case of duodenal diverticulum at the level of the ampulla of Vater is presented. Examination showed that the patient had been suffering from post-prandial distress localized to this region.

S. R. BEATTY, M.D.

GYNECOLOGY AND OBSTETRICS

Diagnosis of Placenta Previa by the Use of the Cystogram. Harley E. Anderson. *Urol. and Cutan. Rev.*, 62, 577-581, August, 1938.

The cystogram was used as an aid in diagnosing placenta previa in 22 cases of vaginal bleeding.

Placenta previa was diagnosed by x-ray and confirmed later by operation or delivery in ten cases. One case was diagnosed as positive for placenta previa by cystogram but later proved to be a normal implantation. Five cases showed negative cystograms and no evidence of placenta previa at delivery. One case showing a normal cystogram subsequently proved to be a case of pseudocyesis. Five cases of normal pregnancies were used as control. The author concludes that a careful study of the x-ray films in conjunction with the history and findings in a given case offers the best method of diagnosing placenta previa.

JOHN G. MENVILLE, M.D.

Abdominal Pregnancy at Eight Months. Philip N. Bray. *Minnesota Med.*, 21, 498-500, July, 1938.

Bray quotes Cornell and Lash who reviewed the literature on abdominal pregnancies in 1933, to find that only 35 per cent are diagnosed correctly before operation. The present case is reported because a cystogram was of material aid in diagnosis.

The patient's pregnancy history was not remarkable, and did not particularly suggest extra-uterine pregnancy. Physical examination at term appeared to reveal a mass suggesting the uterus lying in the left side of the pelvis, about the size of a three months' pregnancy, and on the right side of the abdomen a larger mass which at its superior pole suggested a fetal head.

Cystogram with 50 c.c. of 12.5 per cent sodium iodide showed the bladder distorted, its mid and left portions being flattened out, apparently by the breech. Films taken to show position of fetus showed breech presentation, with overlapping of the cranial bones, apparent collapse of the calvarium, and accentuation of the curves, taken as presumptive evidence of fetal death.

Operation revealed the fetus in essentially this position—the uterus to the left, the placenta lying above the uterus but quite distinct from it, and apparently deriving its blood supply mostly from the omental vessels. The fetus was dead. After removal of the products of conception, the patient made an uneventful recovery.

The position of the fetus as diagnosed by routine films plus a cystogram, was essentially corroborated at operation.

PERCY JOSEPH DELANO, M.D.

The Endocrine Factors in Human Sterility: An Evaluation of Diagnostic and Therapeutic Measures. Charles Mazer, S. Leon Israel, and Charles W. Charney. *Pennsylvania Med. Jour.*, 41, 1009-1016, August, 1938.

The various causes of sterile marriages and their

treatment are given in this comprehensive article. The authors state that "the most affective single agent in the treatment of amenorrhea, as the major factor in a sterile marriage, is the irradiation of the pituitary gland and ovaries." A course of three weekly treatments of from fifty to eighty roentgen units is given to each area and is repeated in two or three months if menstrual periodicity has not been established by that time.

The authors advise that a pregnancy test be given each patient in order to avoid irradiation of an unrecognized early embryo.

JOSEPH T. DANZER, M.D.

HEART AND VASCULAR SYSTEM

The Rôle of Mitral Stenosis and of Post-rheumatic Pulmonary Fibrosis in the Evolution of Chronic Rheumatic Heart Disease. Benjamin A. Gouley. *Am. Jour. Med. Sci.*, 196, 11-18, July, 1938.

Chronic heart failure in rheumatic heart disease has been considered to be due to the effects of mitral stenosis, causing, as a result of the stasis, chronic passive congestion and pulmonary vascular hypertension, with subsequent enlargement and eventual failure of the right ventricle.

The valvular obstruction is not the only factor leading to left auricular enlargement, and its importance in initiating the events leading to failure has probably been exaggerated. Seven instances in a series of 61 cases of mitral stenosis were found, in which, despite the presence of a stenotic mitral valve, no enlargement of the auricle had occurred. Another group was noted to have but slight enlargement of this chamber.

The chief factor which determines the severity of the course and the duration of life is the degree of right ventricular strain. This latter is, in some instances, a response to some form of pulmonary resistance, which may or may not develop in the presence of mitral stenosis.

The degree of pulmonary arterial degenerative disease, which is associated with the presence of pulmonary hypertension, is parallel to the degree of right ventricular hypertrophy and strain and to the extent of diffuse fibrosis of the lungs. Pulmonary phlebosclerosis is associated with stasis in the pulmonary veins, usually in left heart failure of whatever cause. In some cases, atherosclerosis and increased firmness of lung structure were present without mitral stenosis. In patients with mitral stenosis without cardiac disability, whose duration of life is long, atherosclerosis is usually slight.

The cause of the pulmonary hypertension is the pulmonary fibrosis, resulting from the rheumatic pneumonitis. Passive pulmonary congestion becomes important with the development of left ventricular failure.

BENJAMIN COPLEMAN, M.D.

Enlargement of the Heart: Its Recognition by the Radiologic Method. Phillip Hallock. *Minnesota Med.*, 21, 303-313, May, 1938.

Hallock reviews first the normal variations, with emphasis on the hypersthenic and hyposthenic habit, the higher diaphragm of old age, and more particularly of childhood. He warns against being misled by a scoliosis, in children of school age.

He quotes Rösler to the effect that many of the very technical methods of mensuration are not only time-consuming but misleading. He stresses the fact that absolute increase in size is not of such importance as relative increases which may speak for hypertrophy of certain chambers. Characteristic patterns of cardiac enlargement thus help one towards an etiologic classification.

He reviews the routine fluoroscopic positions, suggesting that the most valuable one is that in which the patient is turned half right and examined through the left side of the chest, when evaluation of cardiac enlargement is sought. Parkinson and Bedford have described a landmark in the left oblique position of value in study of the aorta. It is the aortic triangle, a translucent triangle formed anteriorly by the left subclavian artery, posteriorly by the spine, and with the roof of the aortic arch forming its base.

If, in the left oblique position (left shoulder to screen) the posterior border of the left ventricle extends beyond the anterior shadow of the spine, it may be considered to be enlarged. It is difficult, if not impossible, to recognize hypertrophy alone by radioscopic examination; it is only when dilatation has supervened that the increased size of the left ventricle can be recognized with certainty.

The barium-filled esophagus distinguishes a persistent right-sided aortic arch by reversal of the usual indentation. The bulge formed by a left auricle increased in size is commented upon, with the warning that this is not pathognomonic for mitral stenosis. Other conditions producing this may be auricular fibrillation, heart block, and enlarged left ventricle.

The Tetralogy of Fallot often gives a characteristic cardiac silhouette, namely, a dextroposed aorta, small or normal sized pulmonary artery, and an enlarged right ventricle.

The author quotes Parkinson and Hoyle in stressing that the heart enlargement of emphysema is principally right ventricular, and that absolute measurements are misleading because of increased chest size. Right ventricular enlargement in this condition is best recognized through a study of the conus. Seen from the front, the prominence of the pulmonary artery is notable in emphysema.

Pulmonary artery enlargement should not be confused with mediastinal tumor. It is observed in patent ductus arteriosus, auricular and ventricular septal defects, and in congenital aneurysm, as well as in mitral stenosis, congestive failure, and early thyroid disease. The so-called hilar dance and pulsations of the pulmonary vessels are irrefutable evidence of pulmonary artery enlargement. PERCY JOSEPH DELANO, M.D.

Development of the Human Heart. A. Barry. *Rhode Island Med. Jour.*, **21**, 76-78, May, 1938.

The author discusses a theory of the development of the human heart based on somewhat controversial, if plausible, hypotheses. He bases his theory on direct observations of preserved fetuses and on similar studies of mammalian embryos. It is of interest to note that the human heart reaches the chambered type of construction by the stage of 3.5 mm., or approximately 26 days, and that, therefore, it is possible from this time on that such functional abnormalities as partial or complete heart block may take place. Drugs in the mother's blood stream, or infections which pass the placenta may affect the developing heart at a very early stage of embryonic growth, and, through partial or temporary failure of the circulation, produce incomplete growth or differentiation in parts not closely connected with the heart.

W. H. GILLENTEINE, M.D.

The Heart in Severe Anemia. C. L. Tung, W. N. Bien, and Y. C. Ch'u. *Chinese Med. Jour.*, **52**, 479-500, October, 1937.

The authors, after reviewing the literature, come to the conclusion that another inherited idea, concerning the heart in anemia, deserves more careful clinical study. They have, therefore, studied ten patients suffering from severe anemia (hemoglobin 2.5 gms. per cent). Clinical, roentgenologic, and electrocardiographic studies were made. Venous pressure determinations and the arm to tongue circulation time (using saccharine) were done. Three patients showed enlarged hearts with no evidence of failure; six showed enlarged hearts with marked failure; one had a normal heart. Increase of the hemoglobin toward normal caused a rapid reduction in heart size, disappearance of diastolic cardiac murmurs and of the sinus tachycardia and large pulse pressure which represents one of the means by which the circulation is adapted to low oxygen-carrying power of the blood, that is, increased cardiac output. Rest in bed has a very favorable influence on these patients, provided the anemia is not severe, the borderline being around 50 per cent hemoglobin (normal 14.5-18.5 gms. per hundred). "Anemia heart" should be considered a clinical entity.

W. H. GILLENTEINE, M.D.

Hydatid Cyst of the Heart: Peculiarities of the Roentgenologic Picture. André Blondeau, Lauprète, and Miramond de LaRoquette. *Bull. et Mém. de Radiol. Méd. de France*, **26**, 194-196, March, 1938.

A case of cardio-pericardiac echinococcus cyst is presented, and the authors discuss the differential diagnosis of cardiac, pulmonary, and pleural localization.

S. R. BEATTY, M.D.

KYMOGRAPHY

The Kymograph in Practical Roentgenology. Pleikart Stumpf. *Röntgenpraxis*, **10**, 289-294, May, 1938.

The ten years since the introduction of kymography

have proved its justification as a helpful diagnostic means. The author describes the practical and technical procedures he uses for the examination of the lungs and the heart, always in connection with fluoroscopy and routine films. He believes that a heart film should always be a kymogram.

For roentgen examination of the gastro-intestinal tract he administers a very small amount of barium (2 or 3 c.c.) and watches its progress by the fluoroscope. A kymographic examination of the esophagus is done, if indicated; the time of the exposure being cut from the usual five to three seconds. The first step for the examination of the stomach is the demonstration of the mucosa relief, which is done after massaging the stomach and with a slight tilt of the body for the demonstration of the cardiac portion. Following this procedure 250 c.c. of a barium mixture are given under fluoroscopic control. Fluoroscopic observation of the peristalsis is not necessary when a kymogram is made of the stomach. In 75 per cent of the cases the movements of the emptying stomach, the pylorus, and the duodenal cap are also demonstrated. In some cases serial instantaneous spot films of pylorus and duodenum are necessary for more information. The kymographic films are examined in the kymoscope. In a considerable number of cases the author has seen pathologic kymograms which caused him to re-examine the patient with more attention to the questionable area. He succeeded thus in finding small lesions which he would have missed by the routine examination.

Kymographic examination of the small intestines should be done using an exposure time of 15 seconds. Peristalsis, contraction, and changes in the tonus may be seen in the kymoscope.

The author believes that a kymogram of the colon is of particular value. The examination time must be extended to from three to six minutes in order to demonstrate the different movements of the colon. The amount of radiation necessary in these cases (0.5 milliampere, 60 kilovolts, one meter distance) is not too large, and not greater than the radiation used for a kymogram of the stomach.

Examination of the gall bladder and the kidneys may be done with a kymograph, but there are no data available as yet for its evaluation.

The field it may occupy in examination of the spine, skeleton, joints, bronchography, arteriography, etc., has not been investigated. The author believes that it is possible that it may be of help in these fields.

HANS W. HEFKE, M.D.

THE LUNGS

Roentgenologic Study of Paragonimiasis of Lungs. S. H. Wang and C. K. Hsieh. *Chinese Med. Jour.*, **52**, 829-842, December, 1937.

The authors present the second report to be found in the literature on the clinical and experimental roentgenologic appearance of paragonimiasis. Nine human cases and a cat with this disease were studied and the x-ray appearance compared with autopsy findings. Roentgenologic appearance alone is insufficient for

demonstration. The history and clinical course give considerable help, but the presence of the ova of the parasite in the sputum is the deciding factor.

W. H. GILLENTE, M.D.

Radiologic Measurements of the Apico-basal Relaxation of the Lung during Artificial Pneumoperitoneum Treatment. Andrew L. Banyai. *Am. Jour. Med. Sci.*, 196, 207-211, August, 1938.

In order to determine the effects of artificial pneumoperitoneum on the elevation of the diaphragm, films were made in deep inspiration and deep expiration, and compared with similar films made before treatment was started. The basis for comparison was the linear dimension obtained by measuring the highest point of the apex of the lung from the highest point of the corresponding dome of the diaphragm.

The upward displacement of the diaphragm is influenced by (1) the tonicity and integrity of the diaphragm, (2) the tonicity of the abdominal wall, (3) pathologic changes in or about the lung, (4) the type of breathing (there is a greater tendency toward collection of subdiaphragmatic air in patients with a distinctly thoracic type of breathing than in other types), and (5) the amount of air injected.

Intraperitoneal air injections given at weekly intervals are likely to cause a sustained elevation of the diaphragm provided adhesions are not present. The author feels that the extent of elevation induced (between 6 and 7 cm.) is enough to aid in the relaxation of the lung to further healing. There was a reduction of about 30 per cent in the apico-basal length in those cases treated.

BENJAMIN COPLEMAN, M.D.

Cavernous Hemangiomas of the Lung with Secondary Polycythemia. C. B. Rodes. *Jour. Am. Med. Assn.*, 110, 1914, 1915, June 4, 1938.

This is a report of a case of multiple hemangiomas of the lung with rupture into the bronchus. A review of the literature failed to find a record of polycythemia

complicated by hemangioma of the lung. Several reports of malignant types of hemangioma of the lung and pleura were found, as well as of both benign and malignant lesions of other viscera. The roentgenograms in this case showed findings similar to those reported in other cases, namely, nodular areas in one or the other lung-field.

CHARLES G. SUTHERLAND, M.D.

Remarks on the Information Furnished by Tomography in Tuberculosis and Abscess of the Lung. Vaucher and Uhrig. *Bull. et mém. Soc. Radiol. Méd. de France*, 26, 38, 39, January, 1938.

It is possible, at times, to discover, by tomography, a cavity not demonstrated by ordinary radiographic methods. Tomography also permits more accurate localization of such lesions as abscess of the lung where in the optimum surgical approach must be determined. Frequently it is only by tomography that the true condition of the thoracic structures can be demonstrated. Illustrative cases are presented in abstract.

S. R. BEATTY, M.D.

Tuberculosis of the Azygos Lobe. H. Choussat. *Bull. et Mém. de Radiol. Méd. de France*, 26, 185-190, March, 1938.

The author discusses the diagnosis of tuberculosis of the azygos lobe and presents a case in which this lesion was well demonstrated by a therapeutic pneumothorax.

S. R. BEATTY, M.D.

Primary Carcinoma of the Lung and Syphilis. Candido Maderno. *Arch. di Radiol.*, 14, 16-29, January-February, 1938.

Four cases are reported, all in patients with syphilis and all in workers with tar and petroleum products. The possible interrelationships of these factors in producing pulmonary cancer are discussed.

E. T. LEDDY, M.D.

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